GE Healthcare

Optima XR200amx/XR220amx
System Manual

Direction 5336122-1EN, Rev 12

ATTENTION

LES APPAREILS A RAYONS X SONT DANGEREUX A LA FOIS POUR LE PATIENT ET POUR LE MANIPULATEUR SI LES MESURES DE PROTECTION NE SONT PAS STRICTEMENT APPLIQUEES

Bien que cet appareil soit construit selon les normes de sécurité les plus severes, la source de rayonnement X représente un danger lorsque le manipulateur est non qualifié ou non averti. Une exposition excessive au rayonnement X entraîne des dommages a l'organisme. Par conséquent, toutes les précautions doivent être prises pour éviter que les personnes non autorisées ou non qualifées utilisent cet appareil créant ainsi un danger pour les autres et pour elles-mêmes. Avant chaque manipulation, les personnes qualifiées et autorisées à se servir de cet appareil doivent se renseigner sur les mesures de protection etablies par la Commission Internationale sur la Protection Radiologique, Annales 26: Recommandations de la Commission Internationale sure la Protection Radiologique et les normes nationales en vigueur.

WARNING

X-RAY EQUIPMENT IS DANGEROUS TO BOTH PATIENT AND OPERATOR UNLESS MEASURES OF PROTECTION ARE STRICTLY OBSERVED.

Though this equipment is built to the highest standards of electrical and mechanical safety, the useful x-ray beam becomes a source of danger in the hands of the unauthorized or unqualified operator. Excessive exposure to x-radiation causes damage to human tissue.

Therefore, adequate precautions must be taken to prevent unauthorized or unqualified persons from operating this equipment or exposing themselves or others to its radiation.

Before operation, persons qualified and authorized to operate this equipment should be familiar with the Recommendations of the International Commission on Radiological Protection (ICRP), contained in Annals Number 26 of the ICRP, and with applicable national standards.

ATENCION

LOS APARATOS DE RAYOS X SON PELIGROSOS PARA EL PACIENTE Y EL MANIPULADOR CUANDO LAS NORMAS DE PROTECCION NO ESTAN OBSERVADAS

Aunque este aparato está construido según las normas de seguridad más estrictas, la radiacion X constituye un peligro al ser manipulado por personas no autorizadas o incompetentes. Una explosicion excesiva a la radiación X puede causar daños al organismo.

Por consiguiente, se deberán tomar todas las precauciones necesarias para evitar que las personas incompetentes o no autorizadas utilicen este aparato, lo que seria un peligro para los demás y para si mismas.

Antes de efectuar las manipulaciones, las personas habilitadas y competentes en el uso de este aparato, deberán informarse sobre las normas de protección fijadas por la Comisión Internacional de la Protección Radiológica, Anales No 26: Recomendaciones de la Comisión Internacional sobre la Protección Radiológica y normas nacionales.

ACHTUNG

RÖNTGENAPPARATE SIND EINE GEFAHR FUR PATIENTEN SOWIE BEDIENUNGSPERSONAL, WENN DIE GELTENDEN SICHERHEITSVORKEHRUNGEN NICHT GENAU BEACHTET WERDEN

Dieser Apparat entspricht in seiner Bauweise strengsten elektrischen und mechanischen Sichereitsnormen, doch in den Händen unbefugter oder unqualifizierter Personen wird er zu einer Gefahrenquelle.

Übermäßige Röntgenbestrahlung ist für den menschlichen Organismus schädlish.

Deswegen sind hinreichende Vorsichtsmaßnahmen erforderlich, um zu verhindern, daßunbefugte oder unqualifizierte Personen solche Geräte bedienen oder sich selbst und andere Personen deren Bestrahlung aussetzen können.

Vor Inbetriebnahme dieses Apparats solite sich das qualifizierte und befugte Bedienungspersonal mit den geltenden Kriterien für den gefahrlosen Strahleneinsatz durch sorgfältiges Studium des Hefts Nr. 26 der Internationalen Kommission für Strahlenschutz (ICRP) vertraut machen: Empfehlungen der Internationalen Kommission für Strahlenschutz und anderer nationaler Normenbehörden.

Important information

WARNING (EN)	This service manual is available in English only. • If a customer's service provider requires a language other than English, it is the customer's responsibility to provide translation services. • Do not attempt to service the equipment unless this service manual has been consulted and is understood. • Failure to heed this warning may result in injury to the service provider, operator or patient from electric shock, mechanical or other hazards.
ПРЕДУПРЕЖДЕНИЕ (BG)	Това упътване за работа е налично само на английски език. • Ако доставчикът на услугата на клиента изиска друг език, задължение на клиента е да осигури превод. • Не използвайте оборудването, преди да сте се консултирали и разбрали упътването за работа. • неспазването на това предупреждение може да доведе до нараняване на доставчика на услугата, оператора или пациента в резултат на токов удар, механична или друга опасност.
警告 (ZH-CN)	本维修手册仅提供英文版本。 • 如果客户的维修服务人员需要非英文版本，则客户需自行提供翻译服务。 • 未详细阅读和完全理解本维修手册之前，不得进行维修。 • 忽略本警告可能对维修服务人员、操作人员或患者造成电击、机械伤害或其他形式的伤害。
警告 (ZH-HK)	本服務手冊僅提供英文版本。 • 倘若客戶的服務供應商需要英文以外之服務手冊，客戶有責任提供翻譯服務。 • 除非已參閱本服務手冊及明白其內容，否則切勿嘗試維修設備。 • 不遵從本警告或會令服務供應商、網絡供應商或病人受到觸電、機械性或其他的危險。
警告 (ZH-TW)	本維修手冊僅有英文版。 • 若客戶的維修廠商需要英文版以外的語言，應由客戶自行提供翻譯服務。 • 請勿試圖維修本設備，除非 您已查閱並瞭解本維修手冊。 • 若未留意本警告，可能導致維修廠商、操作員或病患因觸電、機械或其他危險而受傷。
UPOZORENJE (HR)	Ovaj servisni priručnik dostupan je na engleskom jeziku. • Ako davatelj usluge klijenta treba neki drugi jezik, klijent je dužan osigurati prijevod. • Ne pokušavajte servisirati opremu ako niste u potpunosti pročitali i razumjeli ovaj servisni priručnik. • zanemarite li ovo upozorenje, može doći do ozljede davatelja usluge, operatera ili pacijenta uslijed strujnog udara, mehaničkih ili drugih rizika.
VÝSTRAHA (CS)	Tento provozní návod existuje pouze v anglickém jazyce. • V případě, že externí služba zákazníkům potřebuje návod v jiném jazyce, je zajištění překladu do odpovídajícího jazyka úkolem zákazníka. • Nesnažte se o údržbu tohoto zařízení, aniž byste si přečetli tento provozní návod a pochopili jeho obsah. • V případě nedodržování této výstrahy může dojít k poranění pracovníka prodejního servisu, obslužného personálu nebo pacientů vlivem elektrického proudu, respektive vlivem mechanických či jiných rizik.
ADVARSEL (DA)	Denne servicemanual findes kun på engelsk. • Hvis en kundes tekniker har brug for et andet sprog end engelsk, er det kundens ansvar at sørge for oversættelse. • Forsøg ikke at servicere udstyret uden at læse og forstå denne servicemanual. • Manglende overholdelse af denne advarsel kan medføre skade på grund af elektrisk stød, mekanisk eller anden fare for teknikeren, operatøren eller patienten.

WAARSCHUWING (NL)	Deze onderhoudshandleiding is enkel in het Engels verkrijgbaar. • Als het onderhoudspersoneel een andere taal vereist, dan is de klant verantwoordelijk voor de vertaling ervan. • Probeer de apparatuur niet te onderhouden alvorens deze onderhoudshandleiding werd geraadpleegd en begrepen is. • Indien deze waarschuwing niet wordt opgevolgd, zou het onderhoudspersoneel, de operator of een patiënt gewond kunnen raken als gevolg van een elektrische schok, mechanische of andere gevaren.
HOIATUS (ET)	See teenindusjuhend on saadaval ainult inglise keeles • Kui klienditeeninduse osutaja nõuab juhendit inglise keelest erinevas keeles, vastutab klient tõlketeenuse osutamise eest. • Ärge üritage seadmeid teenindada enne eelnevalt käesoleva teenindusjuhendiga tutvumist ja sellest aru saamist. • Käesoleva hoiatuse eiramine võib põhjustada teenuseosutaja, operaatori või patsiendi vigastamist elektrilöögi, mehaanilise või muu ohu tagajärjel.
VAROITUS (FI)	Tämä huolto-ohje on saatavilla vain englanniksi. • Jos asiakkaan huoltohenkilöstö vaatii muuta kuin englanninkielistä materiaalia, tarvittavan käännöksen hankkiminen on asiakkaan vastuulla. • Älä yritä korjata laitteistoa ennen kuin olet varmasti lukenut ja ymmärtänyt tämän huolto-ohjeen. • Mikäli tätä varoitusta ei noudateta, seurauksena voi olla huoltohenkilöstön, laitteiston käyttäjän tai potilaan vahingoittuminen sähköiskun, mekaanisen vian tai muun vaaratilanteen vuoksi.
ATTENTION (FR)	Ce manuel d'installation et de maintenance est disponible uniquement en anglais. • Si le technicien d'un client a besoin de ce manuel dans une langue autre que l'anglais, il incombe au client de le faire traduire. • Ne pas tenter d'intervenir sur les équipements tant que ce manuel d'installation et de maintenance n'a pas été consulté et compris. • Le non-respect de cet avertissement peut entraîner chez le technicien, l'opérateur ou le patient des blessures dues à des dangers électriques, mécaniques ou autres.
WARNUNG (DE)	Diese Serviceanleitung existiert nur in englischer Sprache. • Falls ein fremder Kundendienst eine andere Sprache benötigt, ist es Aufgabe des Kunden für eine entsprechende Übersetzung zu sorgen. • Versuchen Sie nicht diese Anlage zu warten, ohne diese Serviceanleitung gelesen und verstanden zu haben. • Wird diese Warnung nicht beachtet, so kann es zu Verletzungen des Kundendiensttechnikers, des Bedieners oder des Patienten durch Stromschläge, mechanische oder sonstige Gefahren kommen.
ΠΡΟΕΙΔΟΠΟΙΗΣΗ (EL)	Το παρόν εγχειρίδιο σέρβις διατίθεται μόνο στα αγγλικά. • Εάν ο τεχνικός σέρβις ενός πελάτη απαιτεί το παρόν εγχειρίδιο σε γλώσσα εκτός των αγγλικών, αποτελεί ευθύνη του πελάτη να παρέχει τις υπηρεσίες μετάφρασης. • Μην επιχειρήσετε την εκτέλεση εργασιών σέρβις στον εξοπλισμό αν δεν έχετε συμβουλευτεί και κατανοήσει το παρόν εγχειρίδιο σέρβις. • Αν δεν προσέξετε την προειδοποίηση αυτή, ενδέχεται να προκληθεί τραυματισμός στον τεχνικό σέρβις, στο χειριστή ή στον ασθενή από ηλεκτροπληξία, μηχανικούς ή άλλους κινδύνους.
FIGYELMEZTETÉS (HU)	Ezen karbantartási kézikönyv kizárólag angol nyelven érhető el. • Ha a vevő szolgáltatója angoltól eltérő nyelvre tart igényt, akkor a vevő felelőssége a fordítás elkészíttetése. • Ne próbálja elkezdeni használni a berendezést, amíg a karbantartási kézikönyvben leírtakat nem értelmezték. • Ezen figyelmeztetés figyelmen kívül hagyása a szolgáltató, működtető vagy a beteg áramütés, mechanikai vagy egyéb veszélyhelyzet miatti sérülését eredményezheti.
AÐVÖRUN (IS)	Þessi þjónustuhandbók er aðeins fáanleg á ensku. • Ef að þjónustuveitandi viðskiptamanns þarfnast annas tungumáls en ensku, er það skylda viðskiptamanns að skaffa tungumálaþjónustu. • Reynið ekki að afgreiða tækið nema að þessi þjónustuhandbók hefur verið skoðuð og skilin. • Brot á sinna þessari aðvörun getur leitt til meiðsla á þjónustuveitanda, stjórnanda eða sjúklings frá raflosti, vélrænu eða öðrum áhættum.

AVVERTENZA (IT)	Il presente manuale di manutenzione è disponibile soltanto in lingua inglese. • Se un addetto alla manutenzione richiede il manuale in una lingua diversa, il cliente è tenuto a provvedere direttamente alla traduzione. • Procedere alla manutenzione dell'apparecchiatura solo dopo aver consultato il presente manuale ed averne compreso il contenuto. • Il mancato rispetto della presente avvertenza potrebbe causare lesioni all'addetto alla manutenzione, all'operatore o ai pazienti provocate da scosse elettriche, urti meccanici o altri rischi.
警告 (JA)	このサービスマニュアルには英語版しかありません。 ● サービスを担当される業者が英語以外の言語を要求される場合、翻訳作業はその業者の責任で行うものとさせていただきます。 ● このサービスマニュアルを熟読し理解せずに、装置のサービスを行わないでください。 ● この警告に従わない場合、サービスを担当される方、操作員あるいは患者 さんが、感電や機械的又はその他の危険により負傷する可能性があります。
경고 (KO)	본 서비스 매뉴얼은 영어로만 이용하실 수 있습니다 . • 고객의 서비스 제공자가 영어 이외의 언어를 요구할 경우 , 번역 서비스를 제공하는 것은 고객의 책임입니다 . • 본 서비스 매뉴얼을 참조하여 숙지하지 않은 이상 해당 장비를 수리하려고 시도하지 마십시오 . • 본 경고 사항에 유의하지 않으면 전기 쇼크 , 기계적 위험 , 또는 기타 위험으로 인해 서비스 제공자 , 사용자 또는 환자에게 부상을 입힐 수 있습니다 .
BRĪDINĀJUMS (LV)	Šī apkopes rokasgrāmata ir pieejama tikai angļu valodā. • Ja klienta apkopes sniedzējam nepieciešama informācija citā valodā, klienta pienākums ir nodrošināt tulkojumu. • Neveiciet aprīkojuma apkopi bez apkopes rokasgrāmatas izlasīšanas un saprašanas. • Šī brīdinājuma neievērošanas rezultātā var rasties elektriskās strāvas trieciena, mehānisku vai citu faktoru izraisītu traumu risks apkopes sniedzējam, operatoram vai pacientam.
ĮSPĖJIMAS (LT)	Šis eksploatavimo vadovas yra tik anglų kalba. • Jei kliento paslaugų tiekėjas reikalauja vadovo kita kalba – ne anglų, suteikti vertimo paslaugas privalo klientas. • Nemėginkite atlikti įrangos techninės priežiūros, jei neperskaitėte ar nesupratote šio eksploatavimo vadovo. • Jei nepaisysite šio įspėjimo, galimi paslaugų tiekėjo, operatoriaus ar paciento sužalojimai dėl elektros šoko, mechaninių ar kitų pavojų.
ADVARSEL (NO)	Denne servicehåndboken finnes bare på engelsk. • Hvis kundens serviceleverandør har bruk for et annet språk, er det kundens ansvar å sørge for oversettelse. • Ikke forsøk å reparere utstyret uten at denne servicehåndboken er lest og forstått. • Manglende hensyn til denne advarselen kan føre til at serviceleverandøren, operatøren eller pasienten skades på grunn av elektrisk støt, mekaniske eller andre farer.
OSTRZEŻENIE (PL)	Niniejszy podręcznik serwisowy dostępny jest jedynie w języku angielskim. • Jeśli serwisant klienta wymaga języka innego niż angielski, zapewnienie usługi tłumaczenia jest obowiązkiem klienta. • Nie próbować serwisować urządzenia bez zapoznania się z niniejszym podręcznikiem serwisowym i zrozumienia go. • Niezastosowanie się do tego ostrzeżenia może doprowadzić do obrażeń serwisanta, operatora lub pacjenta w wyniku porażenia prądem elektrycznym, zagrożenia mechanicznego bądź innego.
AVISO (PT-BR)	Este manual de assistência técnica encontra-se disponível unicamente em inglês. • Se outro serviço de assistência técnica solicitar a tradução deste manual, caberá ao cliente fornecer os serviços de tradução. • Não tente reparar o equipamento sem ter consultado e compreendido este manual de assistência técnica. • A não observância deste aviso pode ocasionar ferimentos no técnico, operador ou paciente decorrentes de choques elétricos, mecânicos ou outros.
ATENÇÃO (PT-PT)	Este manual de assistência técnica só se encontra disponível em inglês. • Se qualquer outro serviço de assistência técnica solicitar este manual noutro idioma, é da responsabilidade do cliente fornecer os serviços de tradução. • Não tente reparar o equipamento sem ter consultado e compreendido este manual de assistência técnica. • O não cumprimento deste aviso pode colocar em perigo a segurança do técnico, do operador ou do paciente devido a choques eléctricos, mecânicos ou outros.

ATENŢIE (RO)	Acest manual de service este disponibil doar în limba engleză. • Dacă un furnizor de servicii pentru clienţi necesită o altă limbă decât cea engleză, este de datoria clientului să furnizeze o traducere. • Nu încercaţi să reparaţi echipamentul decât ulterior consultării şi înţelegerii acestui manual de service. • Ignorarea acestui avertisment ar putea duce la rănirea depanatorului, operatorului sau pacientului în urma pericolelor de electrocutare, mecanice sau de altă natură.
ОСТОРОЖНО! (RU)	Данное руководство по техническому обслуживанию представлено только на английском языке. • Если сервисному персоналу клиента необходимо руководство не на английском, а на каком-то другом языке, клиенту следует самостоятельно обеспечить перевод. • Перед техническим обслуживанием оборудования обязательно обратитесь к данному руководству и поймите изложенные в нем сведения. • Несоблюдение требований данного предупреждения может привести к тому, что специалист по техобслуживанию, оператор или пациент получит удар электрическим током, механическую травму или другое повреждение
UPOZORENJE (SR)	Ovo servisno uputstvo je dostupno samo na engleskom jeziku. • Ako klijentov serviser zahteva neki drugi jezik, klijent je dužan da obezbedi prevodilačke usluge. • Ne pokušavajte da opravite uređaj ako niste pročitali i razumeli ovo servisno uputstvo. • Zanemarivanje ovog upozorenja može dovesti do povređivanja servisera, rukovaoca ili pacijenta usled strujnog udara ili mehaničkih i drugih opasnosti.
UPOZORNENIE (SK)	Tento návod na obsluhu je k dispozícii len v angličtine. • Ak zákazníkov poskytovateľ služieb vyžaduje iný jazyk ako angličtinu, poskytnutie prekladateľských služieb je zodpovednosťou zákazníka. • Nepokúšajte sa o obsluhu zariadenia, kým si neprečítate návod na obluhu a neporozumiete mu. • Zanedbanie tohto upozornenia môže spôsobiť zranenie poskytovateľa služieb, obsluhujúcej osoby alebo pacienta elektrickým prúdom, mechanické alebo iné ohrozenie.
ATENCION (ES)	Este manual de servicio sólo existe en inglés. • Si el encargado de mantenimiento de un cliente necesita un idioma que no sea el inglés, el cliente deberá encargarse de la traducción del manual. • No se deberá dar servicio técnico al equipo, sin haber consultado y comprendido este manual de servicio. • La no observancia del presente aviso puede dar lugar a que el proveedor de servicios, el operador o el paciente sufran lesiones provocadas por causas eléctricas, mecánicas o de otra naturaleza.
VARNING (SV)	Den här servicehandboken finns bara tillgänglig på engelska. . • Om en kunds servicetekniker har behov av ett annat språk än engelska, ansvarar kunden för att tillhandahålla översättningstjänster. • Försök inte utföra service på utrustningen om du inte har läst och förstår den här servicehandboken. • Om du inte tar hänsyn till den här varningen kan det resultera i skador på serviceteknikern, operatören eller patienten till följd av elektriska stötar, mekaniska faror eller andra faror.
OPOZORILO (SL)	Ta servisni priročnik je na voljo samo v angleškem jeziku. • Če ponudnik storitve stranke potrebuje priročnik v drugem jeziku, mora stranka zagotoviti prevod. • Ne poskušajte servisirati opreme, če tega priročnika niste v celoti prebrali in razumeli. • Če tega opozorila ne upoštevate, se lahko zaradi električnega udara, mehanskih ali drugih nevarnosti poškoduje ponudnik storitev, operater ali bolnik.
DİKKAT (TR)	Bu servis kılavuzunun sadece ingilizcesi mevcuttur. • Eğer müşteri teknisyeni bu kılavuzu ingilizce dışında bir başka lisandan talep ederse, bunu tercüme ettirmek müşteriye düşer. • Servis kılavuzunu okuyup anlamadan ekipmanlara müdahale etmeyiniz. • Bu uyarıya uyulmaması, elektrik, mekanik veya diğer tehlikelerden dolayı teknisyen, operatör veya hastanın yaralanmasına yol açabilir.

Legal notes

TRADEMARKS

Optima XR200amx™ and Optima XR220amx™ are trademarks of GE Healthcare. WPA and WPA2 are trademarks of the Wi-Fi Alliance. All other products and their name brands are trademarks of their respective holders.

COPYRIGHTS

All material copyright © 2011 by General Electric Company, Inc. All rights reserved. The material presented and contained herein may not be reproduced in any form or manner, without the written permission of General Electric Company, Inc.

Important precautions

DAMAGE IN TRANSPORTATION

All packages should be closely examined at time of delivery. If damage is apparent, have notation “damage in shipment” written on all copies of the freight or express bill before delivery is accepted or “signed for” by a General Electric representative or a hospital receiving agent. Whether noted or concealed, damage MUST be reported to the carrier immediately upon discovery, or in any event, within 14 days after receipt, and the contents and containers held for inspection by the carrier. A transportation company will not pay a claim for damage if an inspection is not requested within this 14 day period.

To file a report, call 1-800-548-3366. Select the option for “Install Support Services for FOA and MIS.” Contact your local service coordinator for more information on this process.

CERTIFIED ELECTRICAL CONTRACTOR STATEMENT

All electrical installations that are preliminary to positioning of the equipment at the site prepared for the equipment shall be performed by licensed electrical contractors. In addition, electrical feeds into the Power Distribution Unit shall be performed by licensed electrical contractors. Other connections between pieces of electrical equipment, calibrations and testing shall be performed by qualified GE Healthcare personnel. The products involved (and the accompanying electrical installations) are highly sophisticated, and special engineering competence is required. In performing all electrical work on these products, GE will use its own specially trained field engineers. All of GE’s electrical work on these products will comply with the requirements of the applicable electrical codes.

The purchaser of GE equipment shall only utilize qualified personnel (i.e., GE’s field engineers, personnel of third-party service companies with equivalent training, or licensed electricians) to perform electrical servicing on the equipment.

IMPORTANT...X-RAY PROTECTION

X-ray equipment if not properly used may cause injury. Accordingly, the instructions herein contained should be thoroughly read and understood by everyone who will use the equipment before you attempt to place this equipment in operation. GE Healthcare will be glad to assist and cooperate in placing this equipment in use.

Although this apparatus incorporates a high degree of protection against x-radiation other than the useful beam, no practical design of equipment can provide complete protection. Nor can any practical design compel the operator to take adequate precautions to prevent the possibility of any persons carelessly exposing themselves or others to radiation.

It is important that anyone having anything to do with x-radiation be properly trained and fully acquainted with the recommendations of the National Council on Radiation Protection and Measurements (NCRP) as published in NCRP Reports available from NCRP Publications, 7910 Woodmont Avenue, Room 1016, Bethesda, Maryland 20814, and of the International Commission on Radiation Protection, and take adequate steps to protect against injury.

The equipment is sold with the understanding that GE Healthcare, its agents, and representatives have no responsibility for injury or damage which may result from improper use of the equipment.

Various protective materials and devices are available. It is urged that such materials or devices be used.

LITHIUM BATTERY CAUTIONARY STATEMENT

DANGER - Risk of Explosion

Danger of explosion if battery is incorrectly replaced.

Replace only with the same or equivalent type recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions.

ATTENTION - Danger d'Explosion

Il y a danger d'explosion s'il y a replacement incorrect de la batterie.

Remplacer uniquement avec une batterie du même type ou d'un type recommandé par le constructeur. Mettre au rébut les batteries usagées conformément aux instructions du fabricant.

TECHNICAL MANUAL UPDATES

When operating or servicing GE Healthcare products, please contact your GE representative for the latest revision of product documentation. Product documentation may also be available on-line at the GE Healthcare support documentation library.

OMISSIONS AND ERRORS

Customers, please contact your GE Healthcare sales or service representatives.

GE personnel, please use the GE Healthcare complaint handling process to report all omissions, errors, and defects in this publication.

Revision history

Revision	Date	Reason for change
1	28SEP2011	Initial release of document.
2	28OCT2011	Updated Regulatory Testing chapter. Refer to SPR HCSDM00103500. Validation updates Refer to SPRs: HCSDM00103500, HCSDM00104175, HCSDM00104185, HCSDM00104239, HCSDM00104254, HCSDM00104548, HCSDM00104550, HCSDM00104554, HCSDM00105012, HCSDM00105013, HCSDM00105014, HCSDM00105016, HCSDM00105017, HCSDM00105018, HCSDM00105019, HCSDM00105021, HCSDM00105022, HCSDM00105023, HCSDM00105027, HCSDM00105246, HCSDM00105247, HCSDM00105248, HCSDM00105249, HCSDM00105252, HCSDM00105253, HCSDM00105257, HCSDM00105259, HCSDM00105262, HCSDM00105479, HCSDM00105537
3	09NOV2011	Updated Load From Cold sections. Refer to SPR HCSDM0010749.
4	14NOV2011	Validation updates. Refer to SPRs: HCSDM00108056, HCSDM00108058, HCSDM00108059, HCSDM00108068, HCSDM00108075, HCSDM00108076, HCSDM00108095, HCSDM00108096, HCSDM00108097, HCSDM00108098
5	17NOV2011	Validation updates. Refer to SPRs: HCSDM00109056, HCSDM00109082
6	05DEC2011	Validation updates. Refer to SPR HCSDM00111281
7	05FEB2012	Added Chapter 4, Section 4.13 - IP Address Change Procedure. Added Note to Chapter 3, Sections 3.2.1.2.1 (after step 14) and 3.2.1.2.2 (after step 15) on changing the Internal IP Address. Updated Chapter 8, Section 8.5.16.3 (step 15) to correct wiring connection from NO to NC. Refer to SPR HCSDM00120703.
8	12JUL2012	Added "Perform QAP" step to Finalization Sections 8.6.2.4, 8.6.3.4, 8.6.5.4, 8.6.6.4, 8.6.7.4, 8.6.8.4, 8.6.8.4, 8.6.15.4. Refer to SPR HCSDM00140842. Updated Chapter 8, Sections 8.4.1 - Drive Wheel and 8.4.4 - Front Caster to show proper lifting/supporting of unit. Refer to TrackWise 8111422.
9	18JUL2012	Updated Chapter 8, Sections 8.4.1 - Drive Wheel and 8.4.4 - Front Caster to show proper lifting/supporting of unit. Refer to SPR HCSDM00147300.

Revision	Date	Reason for change
10	29SEP2012	Updated Chapter 8, Section 8.6.5 - Tube mount - detent side (cathode side) and Section 8.6.6 - Tube mount - friction side (anode side) to show new version of tube mounts. Refer to ECO 2122380. Added text to front material on how to obtain most recent revisions of technical manuals. Satisfies FDA recommendation. Updated PM Checklist and PM Procedures to add hand switch visual inspection, functional checks, cleaning and 3-year replacement. Refer to CAPA 5970812. Added 'Detector firmware download' procedure to the System Data & Software chapter. Refer to SPR HCSDM00157822. Updated Chapter 7, Section 7.1.6.1 Step 4 to "Verify that the selected kVp and mAs are displayed in the protocol modification frames and the left side of the status bar. Both displays should match." Refer to TrackWise 8987140.
11	19SEP2013	Chapter 8, added new Section 8.4.6 - Column replacement. Refer to ECO 2147940. Chapter 7, Section 7.2.2, added Note about potential test equipment damage. Refer to HCSDM00188252. Chapter 4, Section 4.13, updated text in Steps 3 and 6. Refer to HCSDM00185329. Chapter 7, Section 7.1.1, corrected spelling error 'equipmentte'. Refer to HCSDM00188263. Chapter 2, Section 2.4, deleted Section 2.4.3 - PM Checklist. Refer to HCSDM00188249. Chapter 8, added new Section 8.2.4 - Spyder to Board Data Module Cable Replacement. Refer to ECR 2144543. Chapter 8, Section 8.5.11, updated procedure to support new BDM cable. Refer to ECR 2144543. Chapter 4, Sections 4.10.3.1 and 4.10.3.2, added Notes about need to reset system after DAP reconnection. Refer to HCSDM00188256. Chapter 8, Section 8.6.10.3, added Note about need to reset system after DAP reconnection. Refer to HCSDM00188256. Chapter 8, added new Section 8.4.2.3.1 - Battery Pack Integration. Refer to HCSDM00188260. Chapter 8, Section 8.4.1.2.2, added Loctite 242 (2 places). Refer to HCSDM00191982. Chapter 8, Section 8.6.2.3, updated text in Steps 2 and 4 to save existing hardware for reuse. Refer to HCSDM00202552. Chapter 7, added new Section 7.3 - Tube Radiation Leakage Test. Refer to HCSDM00192198. Chapter 8, Section 8.6.2.3 - Column replacement, added note before Step 1 regarding carriage safety lock. Refer to HCSDM00202552. Chapter 3, Section 3.4, updated steps 3-5 with correct navigation links. Refer to HCSDM00188263.
12	14NOV2013	Chapter 5, added new Section 5.6.3 - DAP Calibration. Chapter 2, Table 2-4, added DAP Calibration reference. Chapter 8, Section 8.6.10.4, added step for DAP Calibration. Refer to HCSDM00159583.

Preface Publication Conventions

Standardized conventions for representing information is a uniform way of communicating information to a reader in a consistent manner. Conventions are used so that the reader can easily recognize the actions or decisions that must be made. There are a number of character and paragraph styles used in this publication to accomplish this task. Please become familiar with them before proceeding forward.

It is important that you read and understand hazard statements, and not just ignore them.

Safety & Hazard Information

Proper product safety labeling allows a person to safely use or service a product. The format and style for safety communications reflected in this publication represents the harmonization of IEC/ ISO 3864 and ANSI Z535 standards.

Within this publication, different paragraph and character styles are used to indicated potential hazards. Paragraph prefixes, such as hazard, caution, danger and warning, are used to identify important safety information. Text (Hazard) styles are applied to the paragraph contents that are applicable to each specific safety statement.

Hazard Messages

Any action that will, could or potentially cause personal injury will be preceded by the safety alert symbol and an appropriate signal word. The safety alert symbol is the triangle with an exclamation mark within it. It Is always used next to the signal word to indicate the severity of the hazard. Together, they are used to indicate a hazard exists.

Signal words describe the severity of possible human injures that may be encountered. The alert symbol and signal word are placed immediately before any paragraph they affect. Safety information includes:

1.) Signal Word - The seriousness level of the hazard.
2.) Symbol or Pictorial - The consequence of interaction with the hazard.
3.) Word Message:
    a.) The nature of the hazard (i.e. the type of hazard)
    b.) How to avoid the hazard.

The safety alert symbol is not used when an action can only cause equipment damage.

Text Format of Signal Words

DANGER - INDICATES AN IMMINENTLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY. THIS SIGNAL WORD IS LIMITED TO THE MOST EXTREME SITUATIONS.

WARNING - INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.

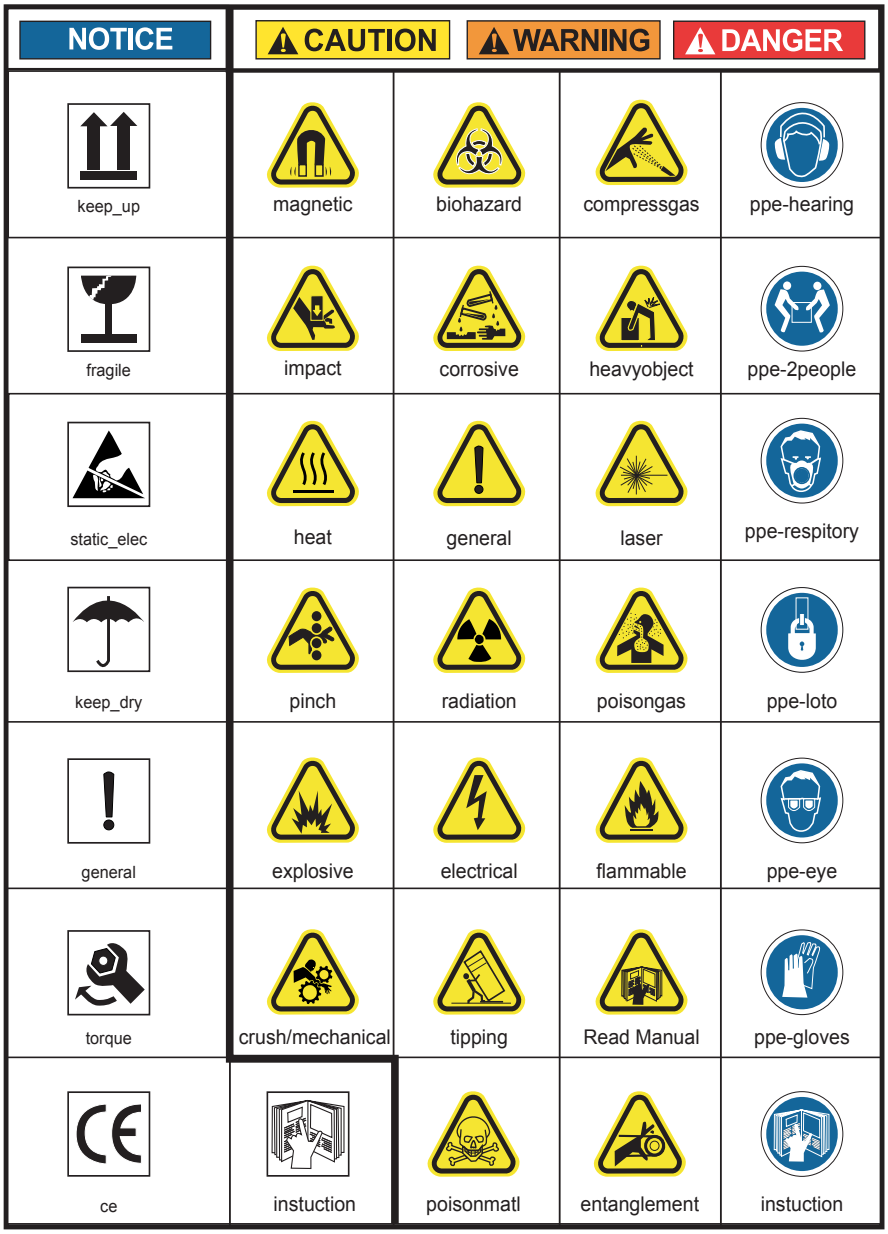
Caution - Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTICE - Indicates information or a company policy that relates directly or indirectly to the safety of personnel or protection of property. This signal word is associated directly with a hazard or hazardous situation and is used in place of 'DANGER,' 'WARNING,' or 'CAUTION.' It can include:

- **Destruction of a disk drive**
- **Potential for internal mechanical damage, such as to a X-ray tube**

Symbols and Pictorials Used

The following Symbols and Pictorials are be used in this publication. These graphical icons (symbols) may be used to make you aware of specific types of hazards that could possibly cause harm.



Publication Conventions

General Paragraph and Character Styles

Prefixes are used to highlight important non-safety related information. Paragraph prefixes (such as Purpose, Example, Comment or Note) are used to identify important but non-safety related information. Text styles are also applied to text within each paragraph modified by the specific prefix.

EXAMPLES OF PREFIXES USED FOR GENERAL INFORMATION:

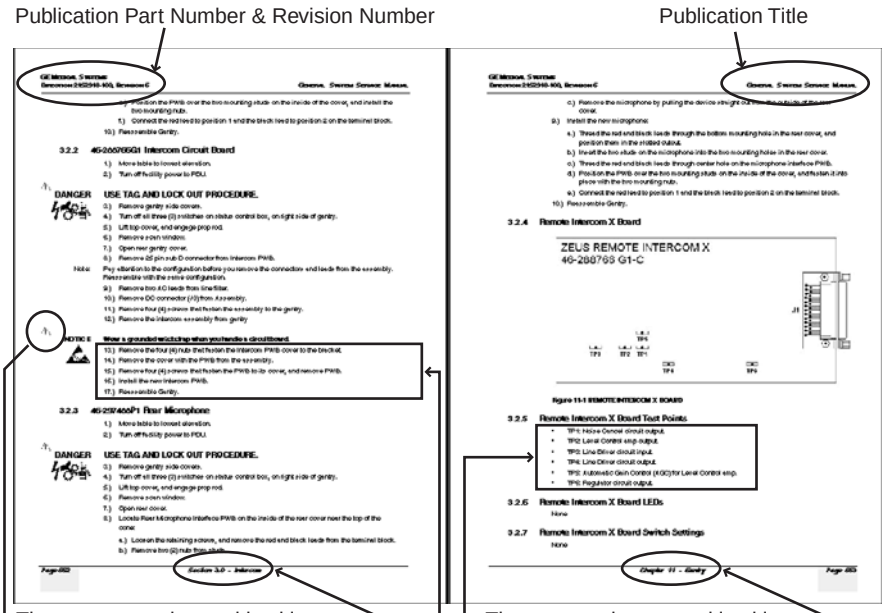
Purpose: Introduces and provides meaning as to the information contained within the chapter, section or subsection (such as used at the beginning this chapter, for example).

Note: Conveys information that should be considered important to the reader.

Example: Used to make the reader aware that the paragraph(s) that follow are examples of information possibly stated previously.

Comment: Represents "additional" information that may or may not be relevant to your situation.

Page Layout


Publication Part Number & Revision Number
Publication Title
The current section and its title are always shown in the footer of the left (even) page.
An exclamation point in a triangle is used to indicate important information to the user.
Paragraphs preceeded by **Alphanumeric** characters (e.g. numbers) contain information that must be followed in a **specific order**.
The current chapter and its title are always shown in the footer of the right (odd) page.
Paragraphs preceeded by a **symbol** (e.g. bullets) contain information that has **no specific order**.

Headers and footers in this publication are designed to allow you to quickly identify your location. The document part number and revision number appears in every header on every page. Odd numbered page footers indicate the current chapter, its title and current page number. Even page footers show the current section and its title, as well as the current page number.

Computer Screen Output/Input Text Character Styles

Within this publication, mono-spaced character styles (fonts) are used to indicate computer text that's either screen input and output. Mono-spaced fonts, such courier, are used to indicated text direction. When you type at your keyboard, you are generating computer input. Occasionally you will see the math operator "greater-than" and "less-than" symbols used to indicate the start and finish of variable output. When reading text generated by the computer, you are reading it as computer generated output. In addition to direction, characters are italicized (e.g. *italics*) to indicate information specific to your system or site.

Example: Fixed Output

```
This paragraph's font represents computer generated screen "fixed"
output. Its output is fixed from the sense that it does not vary from
application to application. It is the most commonly used style used to
indicate filenames, paths and text that do not change from system to
system. The character style used is a fixed width such as courier.
```

Example: Variable Output

This paragraph's font represents computer screen output that is "variable". It is used to represent output that varies from application to application or system to system. Variable output is sometimes found placed between greater-than and less-than operators for clarification. For example: <variable_ouput> or <3.45.120.3>. In both cases, the < and > operators are not part of the actual input.

Example: Fixed Input

This paragraph's font represents fixed input. It is computer input that is typed-in via the keyboard. Typed input that does not vary from application to application or system to system. Fixed text the user is required to supply as input. For example: cd /usr/3p

Example: Variable Input

This paragraph's font represents computer input that can vary from application to application or system to system. With variable text, the user is required to supply system dependent input or information. Variable input sometimes is placed between greater-than and less-than operators. For example: <variable_input>. In these cases, the (<>) operators would be dropped prior to input. For example: **ypcat hosts | grep *<3.45.120.3>* would be typed into the computer as:**

ypcat hosts | grep *3.45.120.3*

without the greater-than and less-than operators.

Buttons, Switches and Keyboard Inputs (Hard & Soft Keys)

Different character styles are used to indicate actions requiring the reader to press either a hard or soft button, switch or key. Physical hardware, such as buttons and switches, are called hard keys because they are hard wired or mechanical in nature. A keyboard or on/off switch would be a hard key. Software or computer generated buttons are called soft keys because they are software generated. Software driven menu buttons are an example of such keys. Soft and hard keys are represented differently in this publication.

Example: Hard Keys

A power switch **ON/OFF** or a keyboard key like **ENTER** is indicated by applying a character style that uses both over and under-lined bold text that is bold. This is a hard key.

Example: Soft Keys

Whereas the computer MENU button that you would click with your mouse or touch with your hand uses over and under-lined regular text. This is a soft key.

Table of contents

Chapter 1 Safety / Before You Begin 23

Section 1.1 Energy sources 23

Section 1.2 Lock Out/Tag Out (LOTO) procedure for electrical power 24

1.2.1 Preparing for LOTO 24
1.2.2 Performing LOTO 26
1.2.3 Returning system to service 29

Section 1.3 Electrostatic discharge (ESD) 30

1.3.1 Important ESD considerations when working on a mobile system 30
1.3.2 Generating static 30
1.3.3 Personal grounding methods and equipment 31
1.3.4 Grounding the work area 31
1.3.5 Recommended materials and equipment 32

Chapter 2 Planned Maintenance 33

Section 2.1 Before you begin 33

Section 2.2 Planned maintenance schedule 33

Section 2.3 System performance 33

Section 2.4 Planned maintenance procedures 33

2.4.1 Before you begin - safety precautions 33
2.4.2 Tools required 33
2.4.3 PM Procedures 34

Chapter 3 System data and software 43

Section 3.1 Backing up system data 43

3.1.1 What is included in a system backup? 43
3.1.2 Performing a system backup 43

Section 3.2 Performing Load From Cold (LFC) 44

3.2.1 Loading or upgrading system software 44

Section 3.3 Performing a FW Load From Cold (LFC) 46

Section 3.4 Restoring generator firmware only 47

Section 3.5 Detector firmware download 47

Section 3.6 Restoring system data 48

3.6.1 Before you begin 48
3.6.2 Restoring system data 48

Section 3.7 System self recovery 49

Chapter 4 Configuration 51

Section 4.1 When should I configure the system? 51

Section 4.2 Using the System Configuration Tool (SUIF) 51

4.2.1 Site configuration 52
4.2.2 Networking configuration 53
4.2.3 General configuration 53
4.2.4 Hardware configuration 54
4.2.5 Generator configuration 54
4.2.6 Wireless configuration 55
4.2.7 Options configuration 57
4.2.8 InSite configuration 58
4.2.9 PNF configuration 58
4.2.10 Time Server configuration 60
4.2.11 Secure Login configuration 60

Section 4.3 Changing Auto Protocol Assist settings 61

Section 4.4 DICOM connectivity configuration 61

4.4.1 Network host configuration 61
4.4.2 Printer configuration 64

Section 4.5 Image management 66

Section 4.6 Image processing 66

4.6.1 Enabling EMI reduction 66

Section 4.7 Loading demo images 67

4.7.1 Loading images from CD 67

Section 4.8 Installing the Operator Manual 67

Section 4.9 Login and user management 68

Section 4.10 Installing hardware options 68

4.10.1 Installing the barcode reader 68
4.10.2 Configuring the barcode reader 71
4.10.3 Installing the Dose Area Product (DAP) meter 74

Section 4.11 Importing custom IP looks from Definium AMX 700 79

Section 4.12 Enabling Advanced Service mode 79

Section 4.13 IP Address Change Procedure 80

4.13.1 Snapshot Tool Configuration 81

Chapter 5 Calibration 89

Section 5.1 Preparing for calibrations 89

5.1.1 Saving changes 89

Section 5.2 Touchscreen calibration 89

5.2.1 Calibrating the touchscreen 89

Section 5.3 Generator calibration 90

5.3.1 Setting filament drive level 90

5.3.2 Viewing and resetting tube and generator usage data ... 91

Section 5.4 Detector calibration ... 91

5.4.1 Executing bad pixel and gain calibrations ... 91

Section 5.5 Image quality calibration ... 93

5.5.1 Calibrating the printer ... 93

Section 5.6 Hardware calibration ... 94

5.6.1 Drive handle calibration ... 94
5.6.2 Touch screen calibration ... 94
5.6.3 DAP calibration ... 94

Section 5.7 PACS image tests ... 97

5.7.1 Comparing PACS test images ... 97
5.7.2 Determining PACS burn/no-burn configuration ... 97
5.7.3 Optional PACS tests ... 101
5.7.4 PACS image comparison results ... 103

Chapter 6 Mechanical adjustment procedures ... 105

Section 6.1 Column related assemblies ... 105

6.1.1 Column balance procedure ... 105
6.1.2 Tube latch to arm pin adjustment procedure ... 108
6.1.3 Column rotational detent procedure ... 111

Chapter 7 Regulatory testing ... 115

Section 7.1 U.S. federally required tests ... 115

7.1.1 Required test equipment ... 115
7.1.2 Preparing for testing ... 115
7.1.3 Collimator testing ... 116
7.1.4 Generator tests ... 122
7.1.5 Beam Quality Test ... 129
7.1.6 Testing generator operator indicators ... 131

Section 7.2 Testing electrical safety ... 131

7.2.1 Performing ground resistance testing ... 131
7.2.2 Performing leakage current testing ... 141

Section 7.3 Tube Radiation Leakage Test - Optional ... 144

7.3.1 Personnel Requirements ... 144
7.3.2 Preliminary requirements ... 144
7.3.3 Purpose ... 145
7.3.4 Common Errors: ... 145
7.3.5 X-Ray Tube Leakage Radiation Requirement: ... 145

Chapter 8 Replacement procedures ... 149

Section 8.1 Cover management ... 149

8.1.1 Side cover removal ... 150
8.1.2 Top cover removal ... 150
8.1.3 Front cover removal ... 152

8.1.4 Front bin removal 156
8.1.5 Rear bin removal 157
8.1.6 Column skirt cover removal 160
8.1.7 Tube head cover removal 161

Section 8.2 Cable replacement 162
8.2.1 General cable replacement 162
8.2.2 High voltage cable replacement 167
8.2.3 "Super cable" 5557068 cable replacement 176
8.2.4 Spyder to Board Data Module Cable Replacement 178

Section 8.3 Software Load From Cold 180

Section 8.4 Base assembly 181
8.4.1 Drive wheel 181
8.4.2 Battery packs 185
8.4.3 Front bumper assembly or bumper switch 191
8.4.4 Front caster 195
8.4.5 Spring applied brake (column rotational brake) 200
8.4.6 Column support assembly 203
8.4.7 Rear bin kickplate 214
8.4.8 Rear bin mounting bracket - Optima XR200amx only 217
8.4.9 Motor brake and motor reducer assembly 219
8.4.10 Caterpillar base transition board 222

Section 8.5 Thorax assembly 224
8.5.1 Spyder system controller 224
8.5.2 Locust drive board 226
8.5.3 Locust drive board fuses 227
8.5.4 Firefly charger board 229
8.5.5 Firefly board fuses 231
8.5.6 Cricket battery board 233
8.5.7 Cricket board fuses 235
8.5.8 Hornet UIF board 237
8.5.9 Drive login active board collector 239
8.5.10 Top cover or display & inverter collector 241
8.5.11 Board data module 245
8.5.12 System PC 247
8.5.13 Wireless USB host radio board 249
8.5.14 Whip antenna 250
8.5.15 Digital detector 252
8.5.16 Detector bin park switch 253
8.5.17 Detector charge cable assembly 255
8.5.18 Detector bin shock absorber 257
8.5.19 Docking connector: detector side 259
8.5.20 Beetle Djinn set of cables 261
8.5.21 Djinn 15kW Auxiliary module 263
8.5.22 Djinn power module 266
8.5.23 Djinn HV tank 268
8.5.24 Djinn 30kW auxiliary module 271
8.5.25 Drive handle assembly 273
8.5.26 Mantis power supply 276
8.5.27 EMI filter 278

8.5.28 LVLE2 281
8.5.29 Power cord reel 284
8.5.30 AC power plug 286
8.5.31 AC fuse holder 289
8.5.32 AC fuses 291
8.5.33 Power switch assembly 294
8.5.34 Overlay board assembly 297
8.5.35 Tube park latch assembly, switch or solenoid 299
8.5.36 Digital power supply assembly 305
8.5.37 Collimator lamp power supply 307
8.5.38 Main circuit breaker and cable assembly 308
8.5.39 Front bin and inner front bin 313

Section 8.6 Column, horizontal arm, X-ray tube, collimator 315
8.6.1 Engaging vertical lock 315
8.6.2 Column 318
8.6.3 Horizontal arm assembly 327
8.6.4 Horizontal arm brake cable assembly with track 331
8.6.5 Tube mount - detent side (cathode side) 339
8.6.6 Tube mount - friction side (anode side) 343
8.6.7 Tube yoke assembly 348
8.6.8 Toshiba X-ray tube 353
8.6.9 Collimator 358
8.6.10 Dose Area Product (DAP) meter 365
8.6.11 SID tape measure 367
8.6.12 Collimator adjustment knob 369
8.6.13 Collimator pointer 370
8.6.14 Collimator lamp 373
8.6.15 Collimator rotation lock finger 377

Appendix A Printer Configuration Information 381
Agfa Drystar 3000 printer parameters 381
Agfa Drystar 5500 printer parameters 384
Codonics Horizon printer parameters 386
Fuji FM DPL printer parameters 388
Fuji DryPix 1000 printer parameters 390
Fuji DryPix 3000 printer parameters 392
Fuji DryPix 7000 printer parameters 394
Kodak 8200 printer parameters 395
Kodak 8500 printer parameters 397
Kodak 8700 printer parameters 399
Kodak 8900 printer parameters 401
Konica Dry Pro 793 printer parameters 402

Chapter 1 Safety / Before You Begin

Section 1.1 Energy sources

Table 1-1

Energy source	Yes/No	Location of energy isolating means	Magnitude of energy
Electrical	Yes	AC power plug	120 VAC/60Hz 220 VAC/50Hz
Electrical	Yes	Circuit breaker	156VDC
Electrical (batteries)	Yes	Battery board connector J1	156VDC
Pneumatic	No	n/a	n/a
Hydraulic	No	n/a	n/a
Gas/water/steam	No	n/a	n/a
Chemical	No	n/a	n/a
Mechanical motion	No	n/a	n/a
Gravity	No	n/a	n/a
Rear suspension spring	No	n/a	n/a
Column spring	Yes	Scroll lock at top of column	610 N-m (5400 in-lbs)
Thermal	No	n/a	n/a
Stored energy (generator capacitors)	Yes	Time discharge and DVM verification	15kW generator: 2200J 30kW generator: 8800J
Air under pressure	No	n/a	n/a
Oil under pressure	No	n/a	n/a
Water under pressure	No	n/a	n/a
Gas under pressure	No	n/a	n/a
Steam	No	n/a	n/a
Other	No	n/a	n/a

Type of equipment and/or method selected to dissipate or isolate stored energy:

- Allow three minutes for stored energy to dissipate. Stored energy is indicated by safety lamps on the generator Aux boxes.
- After waiting period, verify dissipation with volt meter.

Type of equipment and/or method used to ensure disconnections:

- One lock and tag for each electrical power source
- Multiple locking device

Section 1.2 Lock Out/Tag Out (LOTO) procedure for electrical power

Name of equipment: Optima XR200amx/Optima XR220amx
Number of locks: 3
Title of employees authorized to perform LOTO: Those trained in LOTO
Title of affected employees and how to notify: Hospital personnel, notified by verbal communication

1.2.1 Preparing for LOTO

1. Have this equipment on hand:
   - Safety glasses
   - Voltage meter
   - LOTO kit 5421892, contains (see Figure 1-1):
     * 3 brass padlocks and identification labels
     * 3 LOTO tag packages (25 tags per package)
     * 1 electrical plug lockout device 110V - for AC power plug
     * 2 electrical plug lockout devices 160VDC - for battery connectors
     * 1 nylon carry bag

Figure 1-1 LOTO kit contents

2. Locate the AC power plug (E1), system circuit breaker (E2), and battery connectors (E3). See Figure 1-2.

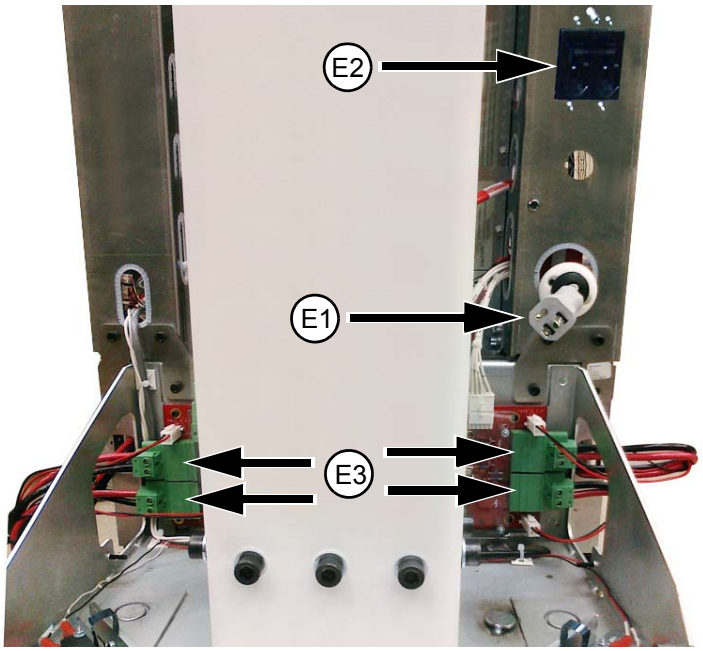


Figure 1-2 Electrical energy lockout locations

1.2.2 Performing LOTO

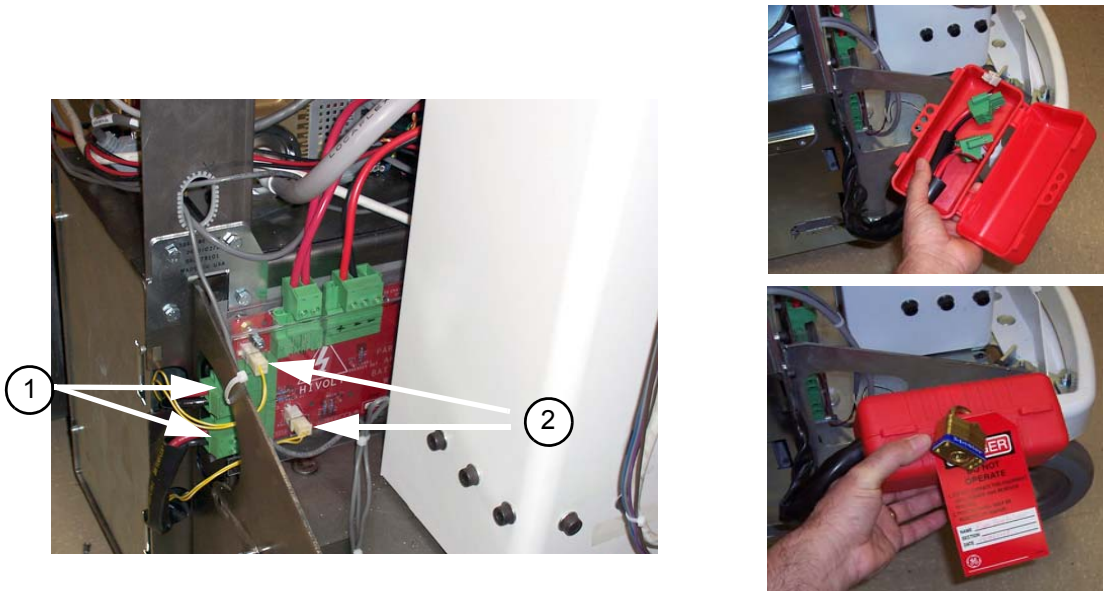
1. Notify all affected personnel working in the area that LOTO is being performed.
2. Exit all system software.
3. Turn off the Optima XR200amx/Optima XR220amx system by pressing the power button and holding it for several seconds until the power button light ring turns blue, indicating that the system is shutting down.
4. When the power light ring begins to blink blue, indicating that the system is in standby, switch the circuit breaker (E2) to the OFF position. See Figure 1-3.

Figure 1-3 Circuit breaker (E2) in OFF position

5. Unplug the power cord from the wall outlet.
6. Apply an approved AC power plug locking device to the AC power plug (E1), then apply your personal red lock and tag. See Figure 1-4.

Figure 1-4 AC power plug with locking device applied

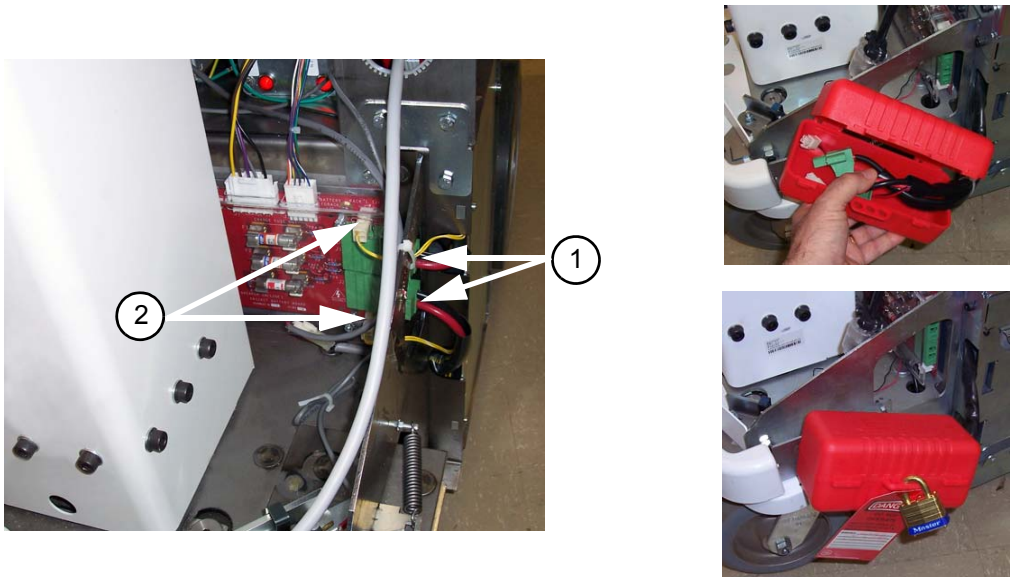
7. Wait three minutes for discharge of stored energy.
8. Disconnect the two green battery power connectors J3 and J4 and the two sense connectors J13 and J14 from the Cricket board. Apply a locking device, then apply your personal red lock and tag. See Figure 1-5.



Item	Description
1	Battery power connectors (J3, J4)
2	Battery sense connectors (J13, J14)

Figure 1-5 Battery connectors J3/J4/J13/J14 and locking device

9. Disconnect the two green battery power connectors J1 and J2 and the two sense connectors J11 and J12 from the Cricket board. Apply a locking device, then apply your personal red lock and tag. See Figure 1-6.

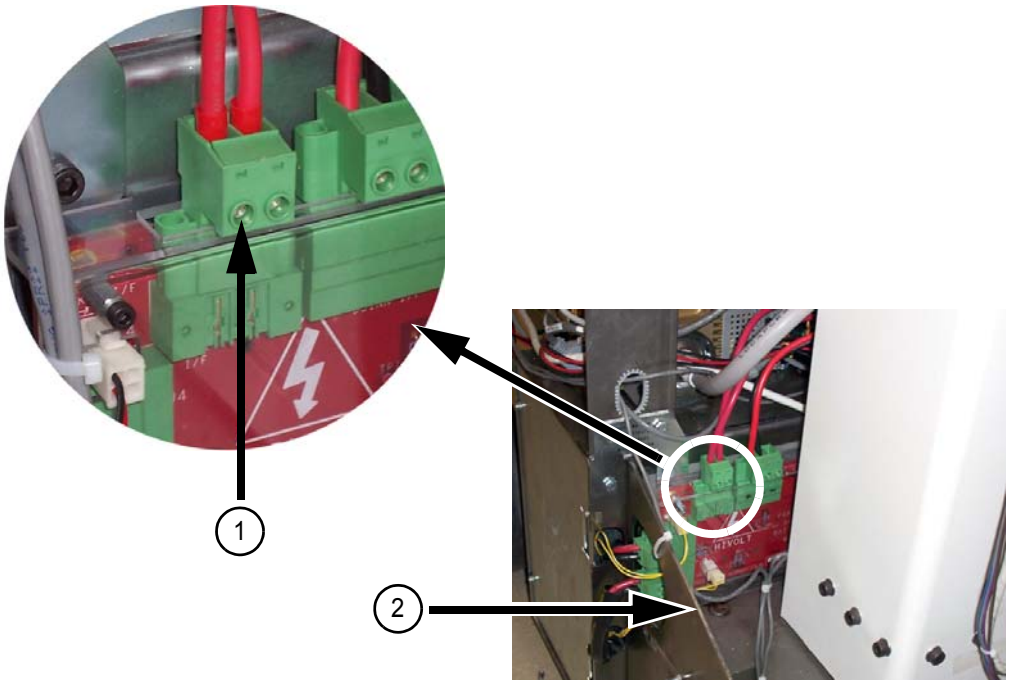


Item	Description
1	Battery power connectors (J1, J2)
2	Battery sense connectors (J11, J12)

Figure 1-6 Battery connectors J1/J2/J11/J12 and locking device

10. Press the power button and verify that the system does not turn on.
11. Verify that the voltage meter is working properly by testing it on a known live voltage source (such as a wall outlet).

12. See Figure 1-7. Verify that electrical power has been removed from the system by applying the DC voltmeter (+) lead to connector J5 pin 1 (Item 1, left-side screw terminal) on the Cricket board and the meter (-) lead to chassis ground (Item 2).



Item	Description
1	Connect DC voltmeter (+) to J5 pin 1 (left-side screw terminal)
2	Connect DC voltmeter (-) to chassis ground

Figure 1-7 Cricket board test points

ELECTRICAL SHOCK HAZARD
IF THE SYSTEM CANNOT BE LOCKED OUT, OR IF THE SYSTEM FAILS VERIFICATION, CONTACT YOUR SUPERVISOR.

13. Perform the necessary service or repair.

1.2.3 Returning system to service

1. Notify affected personnel that LOTO devices are being removed and equipment is being re-energized.
2. Verify that the area is safe to re-energize the equipment.
3. Verify that any safety guards or devices have been reinstalled, and replace all guards and covers as necessary.
4. Remove tools and all non-essential equipment.
5. Verify that all personnel are clear and in a safe position.
6. Verify that all controls and switches are in the off or neutral position.

7. Remove locks and tags as appropriate.
8. Re-energize equipment and follow safe startup procedures.
9. Notify affected persons that energy has been restored.

Section 1.3 Electrostatic discharge (ESD)

A sudden discharge of static electricity from your finger or other conductor can destroy static sensitive devices or microcircuitry. Often the spark is neither felt nor heard, but damage occurs. An electronic device exposed to electrostatic discharge (ESD) might not appear to be affected at all and can work perfectly throughout a normal cycle. The device can function normally for a while, but it has been degraded in the internal layers, reducing its life expectancy.

Networks built into many integrated circuits provide some protection, but in many cases, the discharge contains enough power to alter device parameters or melt silicon junctions.

1.3.1 Important ESD considerations when working on a mobile system

NOTICE

Static Discharge Risk to Components
If you are using a static mat or wrist strap, be sure to connect the mat and strap to machine ground, not earth ground. This is necessary to isolate yourself from earth ground and equalize your potential with the machine.

ESD damage prevention includes these steps:

1. Perform LOTO.
2. Verify that the AC plug is not connected to an energy source/outlet.
3. Connect ground mat and wrist strap assembly to frame connection point of the mobile unit.

1.3.2 Generating static

The following table shows that different activities generate different amounts of static electricity, and that static electricity increases as humidity decreases.

Table 1-2

Event	Relative humidity		
	55%	40%	10%
Walking across carpet	7,500 V	15,000 V	35,000 V
Walking across vinyl floor	3,000 V	5,000 V	12,000 V
Motions of bench worker	400 V	800 V	6,000 V
Removing bubble pack from PCB	7,000 V	20,000 V	26,500 V
Packing PCBs in foam-lined box	5,000 V	11,000 V	21,000 V

Many electronic components are sensitive to ESD. Circuitry design and structure determine the degree of sensitivity. The following packaging and grounding precautions are necessary to prevent damage to electric components and accessories.

- Transport products in static-safe containers to avoid hand contact.
- Protect all electrostatic parts and assemblies with conductive or approved containers or packaging.
- Keep electrostatic sensitive parts in their containers until they arrive at static-free stations.
- Place items on a grounded surface before removing them from their container.
- When handling or touching a sensitive component or assembly, ground yourself by touching the chassis.
- Avoid contact with pins, leads, or circuitry.
- Place reusable electrostatic-sensitive parts from assemblies in protective packaging or conductive foam.

1.3.3 Personal grounding methods and equipment

⚠ WARNING

ELECTRICAL SHOCK HAZARD
This section defines a workzone that is not connected to the system under service. The mobile system is a battery powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures.

Use the following equipment to prevent static electricity damage to equipment:

- Wrist straps are flexible straps with a maximum of one-megohm +/- 10% resistance in the ground cords. To provide a proper ground, wear the strap against bare skin. The ground cord must connect snugly into the banana plug connector on the grounding mat or workstation.
- Heel, toe, and boot straps can be used at standing workstations and are compatible with most types of shoes or boots. On conductive floors or dissipative floor mats, use them on both feet with a maximum of one-megohm +/- 10% resistance between the operator and ground.

1.3.3.1 Static shielding protection levels

Table 1-3

Method	Voltage
Antistatic plastic	1,500
Carbon-loaded plastic	7,500
Metalized laminate	15,000

1.3.4 Grounding the work area

⚠ WARNING

ELECTRICAL SHOCK HAZARD
This section defines a workzone that is not connected to the system under service. The mobile system is a battery powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures.

To prevent static damage of components and parts in the work area:

- Cover the work surface with approved static-dissipative material. Provide a wrist strap connected to the work surface and properly grounded tools and equipment.
- Use static-dissipative mats, foot straps, or air ionizers to give added protection.
- Handle electrostatic sensitive components, parts, and assemblies by case or PCB laminate.
- Handle components only at static-free work areas.
- Turn off power and input signals before inserting and removing connectors or test equipment.
- Use static-safe fixtures when fixtures must directly contact dissipative surfaces.
- Keep work area free of non-conductive materials, like plastic assembly aids and Styrofoam.

1.3.5 Recommended materials and equipment

⚠ WARNING

ELECTRICAL SHOCK HAZARD
This section defines a workzone that is not connected to the system under service. The mobile system is a battery powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures.

Materials and equipment that are recommended for use in preventing static electricity include:

- Anti-static tape, smocks, aprons, or sleeve protectors
- Conductive bins, foam, tabletop workstations with ground cord of one-megohm +/-10% resistance, and other assembly or soldering aids
- Static-dissipative table or floor mats with hard tie to ground
- ESD field service kits
- Static awareness labels
- Wrist straps and footwear straps providing one-megohm +/-10% resistance
- Material handling packages:
  - Conductive plastic bags, plastic tubes and tote boxes
  - Opaque shielding bags
  - Transparent metalized shielding bags and shielding tubes

Chapter 2 Planned Maintenance

Section 2.1 Before you begin

Safe equipment performance and operation requires that personnel servicing the equipment be fully trained on servicing medical X-ray apparatus. General Electric Company, GE Healthcare, and its associates, maintain a world-wide organization that provides skilled X-ray service. If desired, arrangements can usually be made to furnish periodic and/or emergency service on a contract basis. A General Electric representative will be glad to discuss this plan.

Section 2.2 Planned maintenance schedule

The system does not require any planned maintenance (PM) to be performed for a 13 month period following installation. PM schedules should begin in the 13th month that follows the system's installation anniversary date.

Following the 13th month, PM should be performed every 12 months.

The hand switch MUST be replaced at least once every 3 years.

Section 2.3 System performance

Customer discussion - Discuss the system performance with the customer to determine if there are any existing issues.

Section 2.4 Planned maintenance procedures

2.4.1 Before you begin - safety precautions

- Never use solvents or flammable solutions to clean components.
- Never immerse any parts in water or cleaning solutions; apply any liquids to a clean cloth and then use the cloth on the component.
- Always unplug the computer when cleaning with liquids or damp cloths.
- Always unplug the computer before cleaning the air vents.

2.4.2 Tools required

- Standard tool kit
- Dose meter
- kVp meter
- Hioki ground tester (or equivalent)
- Dale leakage current tester (or equivalent)

2.4.3 PM Procedures

PM procedures are divided into the following groups:

1. Visual inspection - See Table 2-1 Visual inspection on page 34.
2. Functional Checks - See Table 2-2 Functional checks on page 35.
3. Cleaning - See Table 2-3 Cleaning on page 36.
4. Calibration - See Table 2-4 Calibration on page 37.
5. HHS Tests - See 2.4.3.7 HHS tests (US-only or as required by local regulations) on page 41.

Table 2-1 Visual inspection

Component	Procedure	Time Est.
Top Cover	• Switch and display markings are clearly legible. • Inspect touch screen and top cover surface for wear or damage. Replace as necessary.	< 1 min.
Collimator	• Field light switch and field size knobs are not loose or damaged. • Guard arms are perpendicular to collimator bottom. • SID indicating tape is attached to left side of collimator. • Rating plate is installed on right side of collimator. • Rating plate is legible. • Rotation Lock is secure and undamaged. • Must be no movement between collimator and tube unit. • Inspect collimator rail stop and plate spring release hardware.	2 min.
X-ray Tube	• Tube Focal Spot label is present (remove top Tube cover)	10 min.
Body	• Drive handle is free from sharp edges. • Tube support column is tight and solid in its mounting. • Inspect wheels for damage. • Verify external covers are properly secured. • Inspect and tighten any loose fasteners.	5 min.
External Cables	• Inspect cables for damage.	< 1 min.
System Rating Plates	• Verify all rating plates are present and legible. - X-ray control, Generator, X-ray tube (on the outside of the unit, next to the main breaker switch). - Beam limiting device (on the side of the collimator).	1 min.
User Interface	• Inspect for damage. • Verify that all labels are legible. • Verify that all LEDs are functional.	5 min.
Power Cord	• Verify good condition of power cord reel, cord and plug.	15 min.
Hand Switch	• Inspect the cord for nicks, cuts or severe pinching of the cord sheath and exposed wires at the RJ 11 connector due to sheath damage. If any of these conditions are observed, replace the cord. • Inspect the hand switch for accumulation of dirt, contrast material, damage to the plastic housing or loosening in the plastic housing.	2 min.

Table 2-2 Functional checks

Component	Procedure	Time Est.
Hand Switch	• Repeatedly press the hand switch buttons (exposure/prepare button and collimator button) to check that the switch moves smoothly from inactive to active positions. • Replace the hand switch if the buttons motion is not smooth or if buttons are sticking. • **NOTE: The hand switch MUST be replaced at least once in every 3 years.**	2 min
Charging	• Plug unit into power outlet. • Power Button is undamaged and illuminates correctly. • Confirm that battery level indicator on top cover is flashing. • Unplug unit from power outlet.	1 min.
Top Cover	• Verify that ambient light sensor is functional by covering sensor with finger and verifying that the screen dims.	< 1 min.
Drive	• Drives forward, reverse, left, and right. • Drive speed is easily controlled. • Inspect bumpers, remove any trapped items. • Drives only in reverse when bumper is pushed in. • Drive forward is inhibited when bumper is pushed in. Test bumper activation from four directions: left-front, right-front, left-side, right-side • Drive speed reduced when tube arm is removed from latch. • Drive speed reduced when a tethered detector is not in the bin and full speed when the detector is parked in the bin. • Drive brakes release when emergency brake release switch is depressed.	20 min.
Tube column and arm	• Horizontal tube arm latch operates smoothly and holds arm securely. • Vertical tube column rotates 270° from latch position to latch position. • Tube arm moves smoothly from bottom to top of vertical column. • Tube arm extends and retracts smoothly. • Tube unit rotates 90° to horizontal in both directions. • Tube unit rotates back 10° and forward 110°. • Latch holds column in drive position. • Lock prevents vertical travel. • Lock prevents tube extension. • Lock prevents column rotation.	5 min.

Table 2-2 Functional checks

Component	Procedure	Time Est.
Collimator	• Collimator interface plate is securely fastened to the X-ray tube. If not, DO NOT USE. Service is required. • Verify that three brass tabs hold collimator securely to the collimator interface plate. If not, DO NOT USE. Service is required. • SID tape extends to 6 ft (1830 mm). • SID tape retracts automatically. • Pressing field light buttons on handswitch or on collimator turns field light on. • Rotational detent knob (right side of collimator) must be unscrewed counter-clockwise to rotate collimator. • Tightening rotational detent knob clockwise will secure collimator in any position. • Collimator rotates 90° from center to either side. • Rotational detent knob engages at center and at 90° either side from center. Replace rotational detent knob assembly if excessive rotational movement is present. • Moving transverse (lateral) and longitudinal field sizing knobs moves the respective collimator blades.	15 min.
X-ray	**Caution: Radiation Hazard** **Unit must be in a location where X-rays can be made safely.** • Close collimator blades and move tube arm to its lowest position. • Select lowest kVp and mAs settings. • Pressing the X-ray hand switch button to the first position causes the tube anode to rotate. • Pressing the X-ray hand switch button to the second position makes an exposure. The X-ray tone sounds and X-ray On indicator lights. • Dose report: After exposure, observe that the dose is reported on the technique screen (if DAP is present).	3 min.
Generator	• Test the thermal overload interlock. See 2.4.3.1 Test the thermal overload interlock on page 38.	20 min.
Ground Resistance	• PM item to be completed minimum yearly or as specified by customer. Ground resistance test. See 7.2.1 Performing ground resistance testing on page 131.	20 min.
Leakage Test	• PM item to be completed minimum yearly or as specified by customer. Leakage test. See 7.2.2 Performing leakage current testing on page 141.	20 min.

Table 2-3 Cleaning

Component	Procedure	Time Est.
Touchscreen	• See 2.4.3.4 Clean touchscreen.	2 min.
Film cassette bin (Optima XR200amx only)	• Remove debris from bin.	5 min.
Hand Switch	• See 2.4.3.6 Hand switch cleaning and disinfecting.	5 min.

Table 2-3 Cleaning

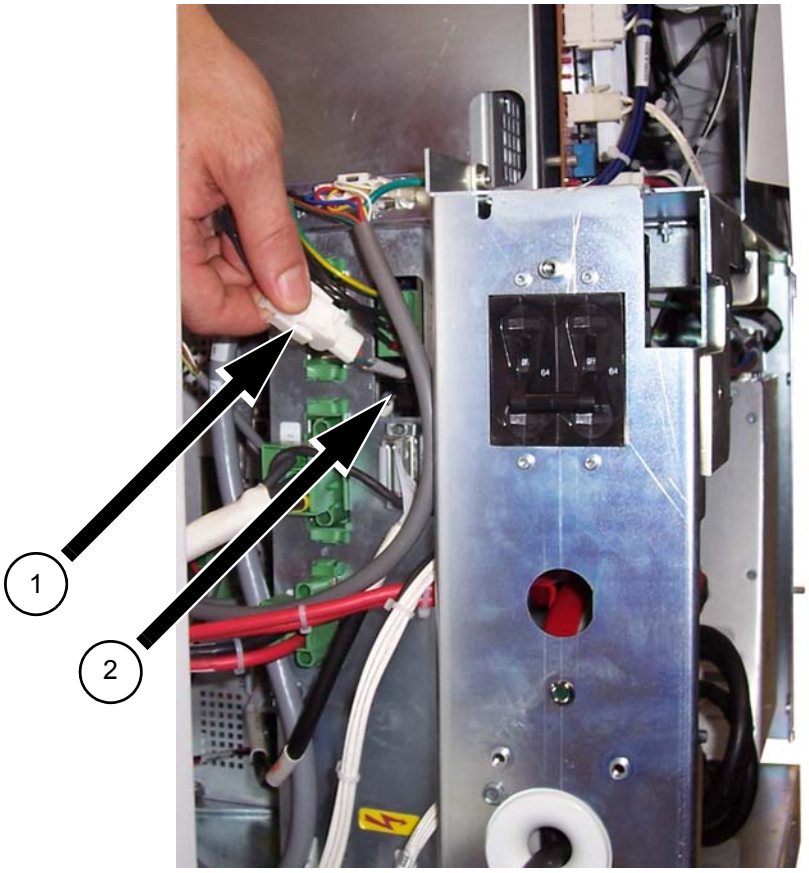
Component	Procedure	Time Est.
Digital detector (Optima XR220amx only)	See 2.4.3.3 Clean digital detector, tether, and grid (Optima XR220amx and Optima XR200amx with digital upgrade only) on page 39.	5 min.
	Visual inspection of detector, tether and grid for damage, wear, labelling, etc.	<1 min.
PC	See 2.4.3.2 Clean PC cooling vents on page 39.	20 min.
Barcode reader (optional - for Optima XR220amx and Optima XR200amx with digital upgrade only)	See 2.4.3.5 Clean barcode reader window (if applicable) - Optima XR220amx and Optima XR200amx with digital upgrade only on page 40.	2 min.
Detector bin (Optima XR220amx and Optima XR200amx with digital upgrade only)	Remove debris from bin. Inspect detector charging connector for damage or mis-alignment. Inspect detector docking switch for damage or mis-alignment. Inspect bin shock absorbers for proper operation and adjustment.	5 min.

Table 2-4 Calibration

Component	Procedure	Time Est.
Touchscreen	• See Section 5.2 Touchscreen calibration on page 89	5 min.
DAP calibration	• See 5.6.3 DAP calibration on page 94	30 min.
QAP	Perform QAP test. See the Optima XR200amx/XR220amx Installation Manual, Chapter 6 Detector checks and QAP	10 min.
Backup	Perform backup of system files. See 3.1.2 Performing a system backup on page 43.	15 min.

2.4.3.1 Test the thermal overload interlock

1. Power off the system.
2. Remove the left side cover and let front cover. See the System manual, Replacement Procedures, Front cover removal.
3. At the front of the unit, to the left of the main circuit breaker, locate the thermal overload cable connector. The thermal overload cable is connected to a short pigtail cable that is plugged into the generator 15 kW auxiliary module. See Figure 2-1.
4. Disconnect the thermal overload cable from the 15 kW auxiliary module.



Item	Description
1	Disconnect thermal overload cable at the pigtail connector
2	OR - - - -disconnect thermal overload cable pigtail from the 15 kW auxiliary module

Figure 2-1 Thermal overload cable connection

5. Turn on system power and wait until it boots to Applications level.
6. Attempt to make an exposure. Verify that the generator aborts the exposure with a tube thermal overload error.
7. Reconnect the thermal overload cable.

2.4.3.2 Clean PC cooling vents

1. Power off the system.
2. Remove the top cover. See the System manual, Replacement Procedures, Top cover removal.
3. Clean the cooling vents of the PC assembly.

2.4.3.3 Clean digital detector, tether, and grid (Optima XR220amx and Optima XR200amx with digital upgrade only)

NOTICE

Potential for equipment damage
The detector, tether and grid should never be immersed in any fluid/chemical. Doing so may cause severe damage to the product. Apply any liquids to a clean cloth and then use the cloth on the component.

1. The detector must have the battery pack OR the tether plugged into the detector handle during cleaning. If the tether is connected to the detector, the other end of the tether must NOT be connected to the system.
2. Wear the recommended personal protective equipment.
3. The detector, tether, and grid may be cleaned with a soft cloth. Avoid use of abrasive materials as this can cause scratches to the detector.
   - Use only GE-approved cleaners:
     * Cidex OPA Solution
     * Incidin Plus
     * Sani-Cloth Plus
     * Gigasept FF
     * Perasafe
     * Trigene II
     * T-Spray Disinfectant Detergent
     * Ster Bac Blue
     * Bacillol Plus

2.4.3.4 Clean touchscreen

NOTICE

Potential for equipment damage
Do not use sprays or aerosols directly on the touchscreen; the liquid might seep into the housing and damage a component. Never use solvents or flammable liquids on the touchscreen.
Follow all safety precautions stated earlier (2.4.1 Before you begin - safety precautions) before cleaning the touchscreen.

- To clean the touchscreen, wipe it with a clean cloth moistened with water or with a towelette designed for cleaning monitors.

2.4.3.5 Clean barcode reader window (if applicable) - Optima XR220amx and Optima XR200amx with digital upgrade only

NOTICE

Potential for Equipment Damage

- **Do not submerge the barcode reader in water. The reader housing is not water-tight.**
- **Do not use abrasive wipes or tissues on the reader window - abrasive wipes may scratch the window.**
- **Never use solvents (alcohol or acetone) on the housing or window - solvents may damage the finish or the window.**

- If the window is visibly dirty, clean the window with a soft cloth or facial tissue dampened with water (or a mild detergent-water solution). If a detergent solution is used, rinse with a clean tissue dampened with water only.
- The scanner housing may be cleaned in the same way.

2.4.3.6 Hand switch cleaning and disinfecting

SAFETY PRECAUTIONS - Before you begin:

- Disconnect the hand switch cord from the body of the hand switch before performing the maintenance / cleaning procedures
- Never use solvents or flammable solutions to clean the hand switch
- Never use dripping cloth (or) immerse hand switch in water or cleaning solutions

INSTRUCTION: Use a cloth moistened in warm soapy water (use mild soap) to clean the hand switch.

APPROVED CLEANERS:

The cleaners listed below are approved to clean the hand switch:

- Bleach - 50% mix with water (5-8% household Bleach)
- Glutaraldehyde <5%
- Polyethylene Glycol <20% (tested as Cidex Plus 28)
- Isopropyl Alcohol 70% concentration
- Hydrogen Peroxide 15-40% concentration

CAUTION: Never use cleaners or solvents of any kind if you are uncertain of the nature of the cleaning agent. The hand switch should be cleaned using EPA cleared and EPA registered high-level disinfecting agents.

2.4.3.7 HHS tests (US-only or as required by local regulations)

Requirements are pass or fail. Service is required if any requirement has failed.

Table 2-5 HHS tests

Inspect	Requirement	Time Est.
1. Generator operator indicators	Check for proper operation of tones and buzzers as required by regulations. See 7.1.6 Testing generator operator indicators on page 131.	10 min.
2. Technique accuracy kVp	See 7.1.4.2 Testing kVp accuracy on page 122.	25 min.
3. Technique accuracy mAs	See 7.1.4.3 Testing mAs accuracy on page 124.	30 min.
4. Linearity	See 7.1.4.4 Testing reproducibility and linearity of exposure on page 127.	40 min.
5. Reproducibility of exposures	See 7.1.4.4 Testing reproducibility and linearity of exposure on page 127.	40 min.
6. Collimator alignment	See 7.1.3.2 Testing light field to X-ray field alignment on page 117.	30 min.
7. Collimator light field intensity	See 7.1.3.1 Testing light intensity on page 116.	15 min.
8. Collimator field size indicator accuracy	See 7.1.3.3 Testing field size indicator accuracy (Optima XR200amx) on page 120 or 7.1.3.4 Testing field size indicator accuracy (Optima XR220amx or Optima XR200amx with digital upgrade) on page 121	30 min.
9. Beam quality half value layer	See 7.1.5.1 Measuring half value layer (HVL) on page 129.	30 min.

Chapter 3 System data and software

Section 3.1 Backing up system data

This section describes the process to save system files, so that there is a valid backup available if the system software ever needs to be reloaded or upgraded.

You will need the external CD/DVD drive and a blank media disk (CD-R or DVD-R format), or a USB drive (i.e. memory stick: It is recommended that you obtain a Sandisk Cruzer 4Gb (GE Part Number 5423551, labeled Daily Use).

The backup takes about ten minutes to complete, but depends upon the amount of data that must be saved. For example, if multiple detectors are registered to the system (Optima XR220amx and Optima XR200amx with digital upgrade only), there are more calibration files that must be saved, resulting in longer backup times.

3.1.1 What is included in a system backup?

During a system backup, the following data is saved:

- Calibration files
- Configuration files

However, the following data is **not** saved by system backup:

- Image data: Use a separate process for archiving image data. See the *Optima XR200amx Operator Manual* or *Optima XR220amx Operator Manual* for instructions.
- Procedure protocols: Save the protocol database only if you have made changes to the default values. Default values are always loaded during a software installation. The default protocol database is included with each shipped system. See the *Optima XR200amx Operator Manual* or *Optima XR220amx Operator Manual* for instructions on saving the protocol database.
- RRA report, DEI report, and Dose report data.

3.1.2 Performing a system backup

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, press LAUNCH.
3. On the SUIF Service Home tab, select the UTILITIES tab.
4. In the left navigation frame, expand the SYSTEM folder.
5. Press the BACKUP link.
6. Select the backup media by selecting CD/DVD or USB.
7. Connect the external CD/DVD drive to the USB ports (2 USB port connections required) and insert supported media (CD-R or DVD -R), or connect a USB drive.
8. Press START.

The status bar displays a series of messages: "Starting BACKUP," "BACKUP successful," and "Backup has completed successfully." The backup takes about one minute, after which the right frame displays "SYSTEM BACKUP SUCCESS."

9. Close the SUIF by pressing EXIT.

Section 3.2 Performing Load From Cold (LFC)

NOTICE

POTENTIAL FOR DATA LOSS

Before installing, upgrading, or restoring system software, be sure to archive all protocols and patient files, and back up calibration and configuration data if possible. Installing software can destroy existing files, including patient, calibration, and configuration files. Avoid reconfiguring and recalibrating the system, and ensure data protection, by periodically performing a system backup. Always perform a system backup before performing a system software load or upgrade.

3.2.1 Loading or upgrading system software

3.2.1.1 Before you begin

Use these procedures to re-install or upgrade the complete system software. The following procedures install both the operating system and application software on the Host PC. To re-install the software takes approximately 15 minutes.

NOTICE

POTENTIAL FOR DATA LOSS

Pay particular attention to the instruction for system reboot in the following procedure. It is important to cycle power according to the specified procedure. Cycling power at the wrong time or by the wrong method can corrupt the system's operating system.

3.2.1.2 Installing the operating system

To upgrade the PC with new operating system, see Section 3.2.1.2.1.

To load the operating system on a PC for the first time, see Section 3.2.1.2.2.

3.2.1.2.1 Upgrading PC with new software:

1. Verify that the system power is on.
2. Connect the service keyboard and external CD/DVD drive to the USB ports on the left side.
3. Save the needed files from the system, such as:
   - Patient images
   - Calibration and configuration data
   - System protocol database as outlined in the Optima XR200amx or Optima XR220amx Operator Manual
   - RRA Report
   - DI Report

- Dose Report

4. Place the **Optima Software DVD** into the external drive.
5. Select SUIF - Calibration - Hardware Calibration page.
6. Select PC Boot Script View and Enable View PC Now and Persistent PC View.

Note: In step 8 below, you will need to enter PC BIOS Mode using the **F11** key. The system is very sensitive to timing in this step. To begin, turn the system on, wait 2 seconds, then start pressing the **F11** key once per second until the boot device selection screen is presented. If the system continues booting (or approximately 30 seconds go by) and you do not see the boot device selection screen, you will have to repeat this procedure. In some cases, if the **F11** key is hit too many times, it can lock the PC such that the keyboard is not recognized. If this occurs, shut the system down using the **POWER RESET** button and try again.

---

7. Shut down the system and restart.
8. Press the **F11** key (see note above) on the service keyboard to display the "`Please Select Boot Device`" menu on the screen.
9. Select the **TEAC** drive from the menu and press the **ENTER** key on the service keyboard.
10. On the next popup, select the option "`1) Install system from this image on this DVD`" and press the **ENTER** key on the service keyboard.
11. The software installation begins.
    Note: Do not walk away during this process, you need to be present. If, during the installation process, the system presents you with a screen to choose either to enter "Degraded Mode" or "Shutdown", click DEGRADED MODE immediately. Then enable View PC Now using PC Boot Script View. If this step is missed, you will not see the PC reboot.
12. Wait for the installation to complete, indicated by an automatic reboot of the PC. It will take approximately 10 minutes to complete. If you missed the note on step 11, the reboot will not be apparent. In this case you will need to start over from step 7 (above).
13. Remove the **Optima Software DVD** from the external DVD/CD-ROM drive. Disconnect the

---

Note: If your customer uses 192.168.x.x for the hospital network connectivity, then you must modify the systems internal IP address scheme. See Section 4.13 IP Address Change Procedure on page 80. This must be done after a Software load and before performing a system Backup/Restore. Failure to follow these instructions will result in boot failures and the system in degraded mode.

---

14. Restore the configuration and calibration files.
15. Enter PC Boot Script View and set View PC Now = DISABLED, and Persistent PC View = OFF.
16. Reset and reboot the system.

3.2.1.2.2 Loading software on a PC for the first time:

Note: During this procedure, enter the "Degraded" mode if prompted. Select Service - Calibration - PC Boot Script View and enable View PC Now and Persistent PC View to continue viewing the PC inputs on the system monitor.

---

1. Verify that the system power is on.
2. Connect the service keyboard and external CD/DVD drive to the USB ports on the left side.
3. Place the Optima Software DVD into the external drive.
4. Select SUIF - Calibration - Hardware Calibration page.
5. Select PC Boot Script View and Enable View PC Now and Persistent PC View.

Note: In step 7 below, you will need to enter PC BIOS Mode using the **F11** key. The system is very sensitive to timing in this step. To begin, turn the system on, wait 2 seconds, then start pressing the **F11** key once per second until the boot device selection screen is presented. If the system continues booting (or approximately 30 seconds go by) and you do not see the boot device selection screen, you will have to repeat this procedure. In some cases, if the **F11** key is hit too many times, it can lock the PC such that the keyboard is not recognized. If this occurs, shut the system down using the **POWER RESET** button and try again.

6. Shut down the system and restart.
7. Press the **F11** key (see note above) on the service keyboard to display the "`Please Select Boot Device`" menu on the screen.
8. Select the **TEAC** drive from the menu and press the **ENTER** key on the service keyboard.
9. On the next popup, select the option "`1) Install system from this image on this DVD`" and press the **ENTER** key on the Service Keyboard.
10. The software installation begins.
    Note: Do not walk away during this process, you need to be present. If, during the installation process, the system presents you with a screen to choose either to enter "Degraded Mode" or "Shutdown", click DEGRADED MODE immediately. Then enable View PC Now using PC Boot Script View. If this step is missed, you will not see the PC reboot.
11. Wait for the installation to complete, indicated by an automatic reboot of the PC. It will take approximately 10 minutes to complete. If you missed the note on step 10, the reboot will not be apparent. In this case you will need to start over from step 6 (above).
12. Remove the Optima Software DVD from the external DVD/CD-ROM drive. Disconnect the external drive from the system. The Load From Cold procedure is now complete.
13. Enter PC Boot Script View and set View PC Now = DISABLED, and Persistent PC View = OFF.

Note: If your customer uses 192.168.x.x for the hospital network connectivity, then you must modify the systems internal IP address scheme. See Section 4.13 IP Address Change Procedure on page 80. This must be done after a Software load and before performing a system Backup/Restore. Failure to follow these instructions will result in boot failures and the system in degraded mode.

15. Restore the configuration and calibration files.

3.2.1.3 Finalization

1. Perform the functional checks under X-ray in Table 2-2 Functional checks on page 35.
2. For Optima XR220amx or Optima XR200amx with digital upgrade, verify that images can be created and transferred via networking (as applicable).

Section 3.3 Performing a FW Load From Cold (LFC)

1. Shut down the system and turn the main circuit breaker off.
2. Wait one minute, then restore power and boot the system.
3. On the Applications desktop, press the UTILITIES button.
4. On the Utilities desktop, press LAUNCH.

5. On the Service Home tab, press the UTILITIES tab button.
6. Press the SUBSYSTEM SOFTWARE button.
7. Press the HW FIRMWARE INSTALL button.
8. Press the DOWNLOADS link.
9. Select HW FIRMWARE INSTALL.
10. Connect the USB firmware dongle to the single USB port on the right.
11. Follow the on-screen instructions.
12. After the firmware load is completed, remove the USB firmware dongle.
13. Reboot the system for the operating system install to complete.
14. If the system presents a BDM mismatch, select CANCEL to update the BDM board with the new firmware.
    Note: The BDM backup process takes approximately 25 minutes to complete. If, after 30 minutes, the BDM mismatch splash screen does not close, reset the system using the power on/off button. Do not reset the system until **at least** 30 minutes has expired since pressing CANCEL above. Upon system reboot, the BDM mismatch splash screen should not appear, indicating a successful backup. If the BDM mismatch splash screen reappears, select CANCEL as the backup was not successful. This BDM mismatch splash screen behavior is very intermittent.
15. Restore generator TNT data. See Section 3.6 Restoring system data on page 48.

Section 3.4 Restoring generator firmware only

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, press LAUNCH.
3. On the Service Home tab, press the UTILITIES tab button.
4. Press the SUBSYSTEM SOFTWARE button.
5. Press the HW FIRMWARE INSTALL link.
6. Select DOWNLOADS, then GENERATOR SW INSTALL.
7. Follow the on-screen instructions.
8. Reboot the system for the restore to take effect.
9. Restore generator TNT data. See Section 3.6 Restoring system data on page 48.

Section 3.5 Detector firmware download

This section applies to Optima XR200amx with digital upgrade and Optima XR220amx systems only.

Note: The first time a new detector is used with an Optima XR220amx or Optima XR200amx with digital upgrade system, detector firmware must downloaded because the existing firmware present on the detector may not be compatible with the system. If you attempt to use a detector that does not have the correct firmware, an error message will be displayed stating `The detector is not compatible with this system.` or `Digital cassette firmware is incorrect.`

1. Ensure the system has booted to applications without error.
2. Connect the detector to the system using the tether and ensure the detector is on, Detector Status Led illuminated.
3. Power on the detector.
4. On the Applications desktop, press the UTILITIES button.
5. On the Utilities desktop, press LAUNCH.
6. On the Service Home tab, press the UTILITIES tab button.
7. In the left navigation frame, expand the SUBSYSTEM SOFTWARE folder.
8. Select DET DATA DOWNLOAD folder.
9. Select DET DATA DOWNLOAD link.
10. Select the appropriate detector.
11. Follow the on-screen instructions.

Section 3.6 Restoring system data

3.6.1 Before you begin

The following procedure enables you to restore only one selection at a time, so you must repeat the procedure for each item to be restored. To completely restore all of the system files (calibration and configuration), execute this procedure for each of the system items below:

- Digital
- Generator TNT Data
- IUI
- System Control
- IP Looks Optima XR220amx and Optima XR200amx with digital upgrade only
- Digital Cassette Optima XR220amx and Optima XR200amx with digital upgrade only
- OS Configuration

3.6.2 Restoring system data

Note: Do not insert the backup media until the restore utility screen is displayed (step 7).

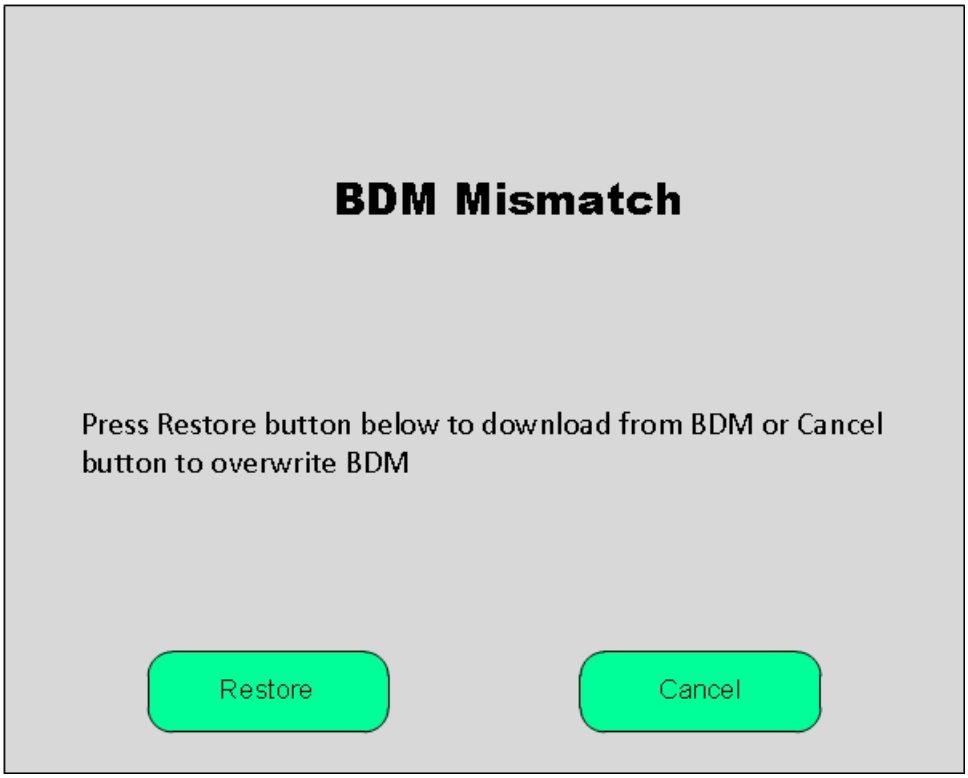
1. On the Applications desktop, press the UTILITIES button.

2. On the Utilities desktop, press LAUNCH.
3. On the Service Home tab, press the UTILITIES tab button.
4. In the left navigation frame, expand the SYSTEM folder.
5. Press the RESTORE link.
6. Select media type: CD/DVD or USB.
7. Follow the on-screen instructions. Remember that each item must be restored individually (there is no 'Restore All').
8. When the status bar indicates that the restore was successful and all items have been restored, exit the SUIF.
9. Reboot the system for the restore to take effect.

Section 3.7 System self recovery

The system hardware has incorporated a design feature which monitors specific components of the system. This monitoring checks configuration details during each system power up. If a mismatch is detected, the user is prompted as to what the correct action should be. This feature enables the system to be self-healing to a limited extent.

If a mismatch is detected, the following screen will be presented.



If this screen is presented for what was a normally operating system (no parts have been changed), always select RESTORE. Failure to do so can result in erratic or failed system behavior.

If parts have been replaced, see the replacement procedures of the System manual, finalization section for the correct selection.

Chapter 4 Configuration

NOTICE

Potential for Data Loss

- Always create an up-to-date backup of system data after changing the configuration.
- For configuration changes to take effect, restart the system after exiting the Service User Interface (SUIF). You must restart the system before using it for patient acquisitions.

Section 4.1 When should I configure the system?

- **During system installation.** The system is delivered with pre-configured information from the manufacturing process. However, many parameters are specific to the customer and location. These parameters need to be configured. Other parameters should be confirmed and/or modified per the customers preference.

Table 4-1

Configuration	Comments
SUIF (Site parameters, Generator parameters, etc.)	See Section 4.2 Using the System Configuration Tool (SUIF) on page 51
DICOM	See Section 4.4 DICOM connectivity configuration on page 61
Demo images	See Section 4.7 Loading demo images on page 67
Operator manual	See Section 4.8 Installing the Operator Manual on page 67
Hardware options such as the barcode reader	See Section 4.10 Installing hardware options on page 68
System login	See Section 4.9 Login and user management on page 68

- **If system backups are lost or missing.** If the software is re-installed but system configuration files are not restored, configure the system again. GE service may need to be contacted to enable purchased options. A software install resets all configuration data. If the system configuration files are restored, you do not need to re-configure the system.
- **After adding purchased options.** Installation of purchased options can only be performed by an authorized GE Healthcare service representative. If you add purchased options to the system, update the system configuration files immediately and create and save a new backup. Purchased option configurations are described in 4.2.7 Options configuration on page 57.

Section 4.2 Using the System Configuration Tool (SUIF)

1. Turn on the system.
2. Log on to the system with administrator privileges.
3. On the Applications desktop, press the UTILITIES button.

4. On the Utilities desktop, next to Service, press LAUNCH.

   The Service Home tab is displayed. The Home tab contains summary information including site identification, connectivity parameters, and enabled options.
5. Press the CONFIGURATION tab button.
6. On the Configuration page, in the left folder tree, select the parameter group to change.
7. Configure the system according to site preferences.

   An overview of the configurable system attributes is given in the tables below.
   Contact a GE service representative for items marked “Editable by GE Healthcare personnel only.”
8. On each page, after making changes, press COMMIT to put the changes into effect.

4.2.1 Site configuration

The following information can be viewed regardless of service mode. However, some fields are editable only by sites with Advanced Service mode enabled (Section 4.12 Enabling Advanced Service mode on page 79), and some are editable only by GE Healthcare personnel.

Table 4-2 Site tab parameters

Parameter	Definition
Site Name	Name of specific site where system is installed.
Street Address 1	Street address of site where system is installed.
Street Address 2	Street address, continued, of site where system is installed.
City	City where system is installed.
State/Province	State or province where system is installed.
Postal Code	Postal or ZIP code where system is installed.
Department Name	Department name (for example, Radiology) responsible for system maintenance.
Telephone	Phone number of department responsible for system.
Fax	Fax number of department responsible for system.
Contact Person Name	Person responsible for system maintenance.
Contact Person Phone	Phone number of person responsible for system maintenance.
System ID	Editable by GE Healthcare personnel only. System identifier assigned by GE Healthcare following system installation and prior to customer turnover. This field is a GE proprietary field and cannot be used for any purpose other than the System ID. Violation of this mandate will result in Insite and/or other features not working. Customer IT personnel need to use other means for DICOM filtering on their DICOM machines.
Installation Date	Editable by GE Healthcare personnel only. Date system installation is completed, created by GE Healthcare.
Service Contract Number	Editable by GE Healthcare personnel only. Customer’s Service Contract number, created by GE Healthcare.
Contract Expiration	Editable by GE Healthcare personnel only. Customer’s Service Contract expiration date, created by GE Healthcare.

4.2.2 Networking configuration

The following information can be viewed regardless of service mode.

Table 4-3 Networking tab parameters

Parameter	Definition
DHCP Configuration	Options: DHCP or Static. Determines whether the IP address is assigned, or acquired dynamically. If Static is selected, enter associated information in IP Address, Subnet Mask, and DNS fields.
IP Address Fixed Only	System IP address. Enabled only if Wired IP Settings is set to Static.
Subnet Mask Fixed Only	System subnet mask. Enabled only if Wired IP Settings is set to Static.
Default Gateway Fixed Only	Default gateway. Enabled only if Wired IP Settings is set to Static.
Static DNS Server 1	Site domain name server. Enabled only if Wired IP Settings is set to Static.
Static DNS Server 2	Site domain name server. Enabled only if Wired IP Settings is set to Static.
AE Title Fixed Only	Application Entity Title for DICOM. Fixed value.
Port Number Fixed Only	Software port used for network communications. Fixed value.

4.2.3 General configuration

If the site is using a master time server (see 4.2.10 Time Server configuration on page 60), some settings in this section are superceded by the master clock server data.

Table 4-4 General tab parameters

Parameter	Definition
Timezone	Time zone of site where system is installed.
System Clock	System time in YYYYMMDD HH:MM:SS format.
Date Display Format	MM-DD-YYYY or DD-MM-YYYY.
Time Display Format	Military (24-hour) or AM/PM (12-hour).
Country Code	Country where system is installed.
Wireless Regulatory Code	A list of selectable countries. The system auto configures to the correct regulatory approved formats and frequencies for all wireless communications. If a country does not allow a specific wireless communication technology then the feature is disabled, Flashpad wireless for example.
Measurement System	English or Metric.

Table 4-4 General tab parameters

Parameter	Definition
Application Language	Language used for application screens.
QAP Timeout (Optima XR220amx or Optima XR200amx with digital upgrade)	Interval between QAP tests, in days. When time-out is reached, system users see a warning flag indicating that a QAP test should be performed.
VA Site	Editable by GE Healthcare personnel only. Applies to USA Veterans Affairs facilities. Yes or No.
Screen Blank Timeout	Period of inactivity (no user input or processing activity) after which the screen will go blank, in minutes.
Image Mask Adjustment (Optima XR220amx or Optima XR200amx with digital upgrade)	Adjust the mask that is applied to the acquired image from the detector. Options: 3mm, 2mm, 1mm, 0, -1mm, -2mm, -3mm.

4.2.4 Hardware configuration

Table 4-5 Hardware tab parameters

Parameter	Definition
Collimator Light Maximum On Time	Time, in seconds, that the collimator light will remain on.
Collimator Lamp Install Date	Date the collimator lamp was installed. YYYY-MM-DD format.

4.2.5 Generator configuration

Table 4-6 Generator tab parameters

Parameter	Definition
Tube HUR Alarm	Percentage of the tube thermal capacity limit, from 0 to 100. When this limit is reached, X-ray exposure is inhibited and an alarm sounds.
Tube ID	Tube ID. Not editable.
Tube Serial	Serial number of the tube. Confirm the serial number matches that of the attached tube.
Tube Install Date and Time	Date and time the tube was installed. YYYYMMDD HH:MM:SS format.

4.2.6 Wireless configuration

Before configuring the wireless settings, verify that the Wireless Hospital Network option is enabled on the Options screen (see 4.2.7 Options configuration on page 57).

4.2.6.1 Adding certificates

If your customer uses site-specific network security certificates, contact the IT administrator to obtain a copy of the certficate(s) on a USB flashdrive.

1. Ensure that the restoration of all configuration parameters has been completed and the system has been reset.
2. Launch the SUIF and navigate to CONFIGURATION > WIRELESS.
3. Launch the wireless configuration utility as instructed on the screen.
4. Connect the USB flashdrive containing the site-specific certificates to a left-side USB port.
5. Click on the Certificates tab.
   a. Observe the USB flashdrive-resident certificates in the pull-down list next to the ADD button.
   b. If there is more than one certificate, you will need to select each certificate individually.
   c. Click ADD to install the displayed certificate from the drop-down list.
6. Continue with the site-specific configurations as defined by the IT administrator.
7. Exit the Configuration utility.
8. Remove the USB flashdrive.
9. Reset the system.

4.2.6.2 Configuring broadcast SSID networks

1. On the Wireless configuration screen, confirm that the "adapter" is ON or ENABLED.
2. Select the Current Status tab.
3. Click SCAN to find the network.

Note: Some customers may have their network access in a non-broadcast mode. This may result in strange naming conventions for the scan results. Confirm with your IT contact.

---

4. In the Scan Results window, double-click the network to which you want to connect.
5. In the Network Config window, some fields are auto-populated. Depending on the type of authentication used by the network, complete the other required information, as described in the table below:

Table 4-7

Authentication type	Required fields
Static WEP (Shared Key authentication)	• WEP keys
WPA™-Personal (PSK)	• Encryption (if different than TKIP) • PSK

Table 4-7

Authentication type	Required fields
WPA™-Enterprise (EAP)	• Encryption (if different than TKIP) • Identity • Password • Client certificate • Inner Auth • Private key file • Private key password • PEAP version (only if EAP method is set to PEAP)
WPA™-Personal (PSK)	• Encryption (if different than TKIP) • PSK
WPA2™-Enterprise (EAP	• Encryption (if different than CCMP) • Identity • Password • Client certificate • Inner Auth • Private key file • Private key password • PEAP version (only if EAP method is set to PEAP)

6. Click ADD.
7. Select the Current Status tab, and click CONNECT. Verify successful connection message.
8. To verify connectivity:
   a. Select **FILE** menu > **TOOLS**.
   b. Enter the IP of the machine you want to ping.
   c. Press START PING and check for messages verifying connectivity.
   d. Press STOP PING.

4.2.6.3 Configuring non-broadcast SSID networks

1. On the Wireless configuration screen, select **NETWORK** menu > **ADD**.
2. Select IP settings:
   - If the system will be identified on the network by a static IP address, select STATIC IP, and enter the IP address, netmask, and gateway. If no gateway is used, you must enter **0.0.0.0**.
   - If the system will be identified on the network using DHCP, select DHCP.
3. Enter the network SSID.
4. Choose the authentication type.

Some fields are auto-populated. Depending on the type of authentication, complete the other required information, as described in the table below:

Table 4-8

Authentication type	Required fields
Static WEP (Shared Key authentication)	• WEP keys
WPA™-Personal (PSK)	• Encryption (if different than TKIP) • PSK
WPA™-Enterprise (EAP)	• Encryption (if different than TKIP) • Identity • Password • Client certificate • Inner Auth • Private key file • Private key password • PEAP version (only if EAP method is set to PEAP)
WPA™-Personal (PSK)	• Encryption (if different than TKIP) • PSK
WPA2™-Enterprise (EAP	• Encryption (if different than CCMP) • Identity • Password • Client certificate • Inner Auth • Private key file • Private key password • PEAP version (only if EAP method is set to PEAP)

5. Click ADD.
6. Select the Networks tab, and verify that the network is listed.
7. Select the Current Status tab, and click CONNECT. Verify successful connection message.
8. To verify connectivity:
   a. Select **FILE** > **TOOLS**.
   b. Enter the IP of the machine you want to ping.
   c. Press START PING and check for messages verifying connectivity.
   d. Press STOP PING.

4.2.6.4 Troubleshooting connections

If you try to connect in an enterprise situation, it will continue to try to connect until you tell it to stop by selecting DISCONNECT.

4.2.7 Options configuration

The Optima XR200amx/XR220amx systems are delivered with a base set of operating software that is configured for immediate operation.

Optional software and hardware purchased by the site must be enabled by GE Healthcare service personnel, such as:

- Wireless network connectivity
- DAP (Dose Area Product) meter (standard with Optima XR220amx, optional for Optima XR200amx)
- Repeat Reject Analysis (RRA) (Optima XR220amx or Optima XR200amx with digital upgrade only)
- Auto Protocol Assist (APA) (Optima XR220amx or Optima XR200amx with digital upgrade only)
- Generator Power - 30kW

4.2.8 InSite configuration

Contact a GE service representative to configure InSite ExC settings.

4.2.9 PNF configuration

The Firewall option at the top of the PNF area must be set to On. If it is set to Off, select TURN FIREWALL ON.

- When the firewall is off, all network traffic in both directions is allowed. This setting is used primarily for troubleshooting.
- When the firewall is on, it allows only the network communications that are specified by its configuration and rejects all the rest.

After modifying any PNF options, select RESTART FIREWALL to apply the changes.

4.2.9.1 PNF GUI Control area

The PNF GUI Control area, near the top of the screen, contains these options:

Table 4-9 PNF GUI Control options

Option	Action
Filter Settings	Configure filter settings that allow access through the firewall by adding allowed services and IP addresses, and removing filters.
Backup/Restore	Options: **BACKUP CURRENT FILTERS**: Create a backup of the current filters. **RESTORE FROM BACKUP FILTERS**: Restore the filters to a previously backed up set. **RESTORE TO FACTORY DEFAULTS**: Reset all filter settings to those originally installed. **REMOVE BACKUP FILTERS**:
Network Tools	Show the firewall rules that are currently in effect on this system. Select **REFRESH** to refresh the list of rules.
Configure PNF	Select which red interfaces the filter settings should be applied to. Select **UPDATE RED INTERFACES** to apply the changes.

4.2.9.2 PNF tabs and parameters

Table 4-10 PNF parameters

Option	Description
Named Services tab Used to set up filters to allow traffic to common network services (such as telnet or ftp) by name, without needing to know the port and protocol.	
Services/Allowed IPs	Lists current filters by name and IP.
Remove Existing Filters	Select the Delete box checkbox next to the filter to delete, then select DELETE EXISTING FILTERS.
Add New Filter	From the Service Name drop-down list, select the service to be allowed (such as telnet, ssh, ftp). In the Allowed IPs field, specify a particular IP address, a range of IP addresses, or a masked subnet. Select ADD FILTER to apply your changes.
Allowed Nodes tab Used to set up filters to allow all traffic from specified nodes. You can specify a particular IP address, a range of IP addresses, or a masked subnet.	
Allowed IPs	Lists current filters by IP.
Remove Existing Filters	Select the Delete box checkbox next to the filter to delete, then select DELETE EXISTING FILTERS.
Add New Filter	In the Allowed IPs field, specify a particular IP address, a range of IP addresses, or a masked subnet. Select ADD FILTER to apply your changes.
DICOM tab Used to add DICOM port numbers (all IP addresses are allowed DICOM access; the DICOM application may limit access by IP). You can add multiple DICOM ports.	
Allowed DICOM Ports	Lists current DICOM ports by number.
Remove Existing Filters	Select the Delete box checkbox next to the port to delete, then select DELETE EXISTING FILTERS.
Add New Filter	In the Allowed Port field, specify a particular DICOM port. Select ADD FILTER to apply your changes.
Expert tab Used to set up detailed filters by port, protocol, and node-lock (source). Used only by advanced IT users.	
Name/Port/Protocol	Lists current filters by name, port number, protocol, and IP.
Remove Existing Filters	Select the Delete box checkbox next to the filter to delete, then select DELETE EXISTING FILTERS.

Table 4-10 PNF parameters

Option	Description
Add New Filter	In the Name field, specify the filter name. In the Allowed IPs field, specify a particular IP address, a range of IP addresses, or a masked subnet. In the Allowed Port field, specify a particular port. From the Protocol drop-down list, select the protocol to be allowed (TCP, UDP, Any). Select ADD FILTER to apply your changes.
NAT tab Used to define NAT (Network Address Translation) rules.	
Name/Source IP/Dest. IP	Lists current filters by name, source IP, destination IP, destination port, and protocol.
Remove Existing Filters	Select the Delete box checkbox next to the filter to delete, then select DELETE EXISTING FILTERS.
Add New Filter	In the Name field, specify the filter name. In the Source IP field, specify the source IP. In the Destination IP field, specify the destination IP. In the Destination Port field, specify the destination port. From the Protocol drop-down list, select the protocol to be allowed (TCP, UDP, Any). Select ADD FILTER to apply your changes.
GE Service tab Used to set IIP node-lock IP address and DICOM port. This page is limited to GE service personnel.	

4.2.10 Time Server configuration

Contact a GE service representative to configure Time Server settings.

4.2.11 Secure Login configuration

Select SAVE to apply your changes, or CANCEL to cancel them.
Use the arrow buttons to move through the pages.

Table 4-11 Secure Login options

Option	Description
Audit Message Settings tab	
Audit Source ID	IP address of audit message source.
Patient Name Anonymized	On or Off.
Enterprise Repository tab	
Enterprise Repository 1	On or Off.
Host Name/IP	Primary audit server name or IP.

Table 4-11 Secure Login options

Option	Description
Port Number	Port number used to communicate with primary audit server.
Protocol	Protocol used to communicate with primary audit server (TCP, UDP).
Send Test Message	Test connection with primary audit server.
Enterprise Repository 2	On or Off.
Host Name/IP	Secondary audit server name or IP.
Port Number	Port number used to communicate with secondary audit server.
Protocol	Protocol used to communicate with secondary audit server.
Send Test Message	Test connection with secondary audit server.
Local Repository tab	
On/Off	Radio buttons.
Refresh	Button to refresh the list.
Event ID / Time / Event Outcome	Headers for list of messages.
Display Raw XML	Display the raw data file to the user.

Section 4.3 Changing Auto Protocol Assist settings

Contact a GE service representative to change Auto Protocol Assist settings.

Section 4.4 DICOM connectivity configuration

Follow the procedures in this section to configure DICOM connectivity to network hosts and printers. After successful configuration, use the tables below to capture the system's DICOM connectivity configuration for future reference. Store the worksheets in a secure location at the site.

4.4.1 Network host configuration

4.4.1.1 Adding network hosts

This section provides instructions for setting the system preferences for network host connections.

1. Turn on the system.
2. On the Applications desktop, press the UTILITIES button.
3. On the Utilities desktop, next to Network Connections, press EDIT.
4. On the Network Connections window, in the Network Hosts section, press ADD.
   The Add Network Host screen appears.
5. On the Add Network Host window, on the Host tab, enter the appropriate values in the fields listed below. Some fields are available only on the Optima XR220amx or Optima XR200amx

with digital upgrade system.

Table 4-12 Add Network Host – Hosts tab description

Function	Description
Host Label	Name of the host that appears in the Network Hosts lists and on the Image Management screen. Host labels cannot contain spaces; use underscores (_) to separate words.
Application Entry Title	DICOM application title.
IP/Network Address	IP address of the network host.
Port Number	Port number for the network host.
Query Retrieve	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. Type of information the host will provide upon query from another host. Options are No provider, Study, and Patient.
Storage Commitment	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. Designates whether the host will store image data.
Storage Commitment - Application Entry Title (if Storage Commitment is Yes)	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. DICOM application title.
Storage Commitment - Network Address (if Storage Commitment is Yes)	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. IP address of the storage database.
Storage Commitment - Port Number (if Storage Commitment is Yes)	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. Port number for the storage database.
Comments	Area for notes about the network host or configuration.

6. Press SAVE.
7. Select the PREFERENCES tab.
8. On the Add Network Host window, on the Preferences tab, select the appropriate options as described below. All options except "Make this network host the HIS/RIS source" are available only on the Optima XR220amx or Optima XR200amx with digital upgrade system.

Table 4-13 Add Network Host – Preferences tab description

Function	Description
Allow this network host to query the (system name)	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. Allows this host to search and filter the system.
Allow this network host to retrieve from the (system name)	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. Allows this host to open and display exams from the system.

Table 4-13 Add Network Host – Preferences tab description

Function	Description
Allow this network host to send images to the (system name)	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. Allows the host to send images to the system.
This network host accepts multiple frame image.	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. Allows multiple frame images to be sent to this network host.
Perform de-identification (anonymous patient images) when sending to this network host.	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. Automatically de-identifies (anonymizes) any images that the system sends to this host.
Apply “Burn-On-Send” to images when sending to this network host.	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. Burns the VOI LUT (Look-Up Tables) into the DICOM header to be displayed by PACS. Leaving this option unselected sends all available VOI LUTs to the DICOM header for PACS to query and apply. Note: PACS should be configured to read the first VOI LUT for proper display of images on the Acquisition workstation.
Send MPPS N-Create and N-Set notification to this network host.	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. This node acts as the Destination for receiving the MPPS NCreate & N-Set Notification. When configured for MPPS, the System sends information like which exam is in progress, when a Study is completed, how many images were acquired, and what was the radiation dose to which the patient was exposed during that session, etc.
Make this network host the HIS/RIS source. (Only one host can be designated as the HIS/RIS source.)	Designates the host as the DICOM Worklist provider. Defining the Radiology Information System (RIS) and Hospital Information System (HIS) host allows patient worklists to be downloaded from those networks to the system. Note: Only one HIS/RIS source may be designated on the system. Selecting this option will de-select any other hosts as the HIS/RIS source.
DR Images sent as CR Modality	Available only on the Optima XR220amx or Optima XR200amx with digital upgrade system. Options are Yes or No.

9. Press SAVE.
10. Repeat this process for each network host device the site wants to add.

4.4.1.2 Performing a C-Echo test

Use this function to determine if the system is communicating with a particular network host.

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, next to Network Connections, press EDIT.
3. On the Network Connections window, in the Network Hosts section, select the network host connection to test, and press C-ECHO TEST.

   A message appears saying whether the test passed or failed.

   - A “passed” message means that the network host is working and that exams can be retrieved from or transferred to it.
   - A “failed” message means that the system could not contact the network host. Perform the following tasks to resolve the problem:
     * Re-try the test at a later time. The host may be temporarily unavailable.
     * Confirm the host configuration on the Edit screen. (On the Network Connections window, in the Network Hosts section, select the network host connection to verify, and press EDIT.

     If the problem persists, contact the technical support group or system administrator.

4.4.1.3 Removing network hosts

Follow these instructions to remove a network host.

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, next to Network Connections, press EDIT.
3. On the Network Connections window, in the Network Hosts section, select the network host connection to delete, and press REMOVE.

   A message appears saying “Are you sure you want to remove (host name)?”
4. Press YES to remove the network host connection.

4.4.2 Printer configuration

Printer connections are available only on the Optima XR220amx or Optima XR200amx with digital upgrade system.

4.4.2.1 Adding printers

This section provides instructions for setting the system preferences for printer connections.

1. Turn on the system.
2. On the Applications desktop, press the UTILITIES button.
3. On the Utilities desktop, next to Network Connections, press EDIT.
4. On the Network Connections window, in the DICOM Printers section, press ADD.

   The Add Printer screen appears.
5. On the Add Printer window, on the Printer tab, enter the appropriate values in the fields listed below.

For suggested parameter values for specific printer brands and models, refer to the System Manual, Appendix A Printer configuration.

Table 4-14 Add Printer screen parameter descriptions

Attribute	Value
Printer tab	
DICOM Printer Label	Name of the printer that appears in the DICOM Printers list and on the print setup screens. DICOM printer labels cannot contain spaces in the name. Use underscores (_) to separate words.
Application Entry Title	DICOM application title, provided by the site's network administrator.
Network Address	IP address of the printer, provided by the site's network administrator.
Port Number	Port number of the printer. May be site-specific; check with site.
Pixel Depth	Resolution of the printer. Options are 10 or 12.
Printer Pixel Size (micron)	Designates the pixel size the printer uses. This is specified by the printer manufacturer.
Configuration Information	Area for notes about the printer or configuration.
Density Min	Minimum density range.
Density Max	Maximum density range.
Magnification Type	Options are Replicate, Bilinear, Cubic, None.
Smooth Factor	Image smoothing factor.
Trim	Designates whether there is to be trim. Yes or No.
Polarity	Options are Normal, Reverse.
Border Density	Color of the image border. Options are Black, White.
Empty Image Density	Color of areas that have no image printed. Options are Black, White.
Printer Memory Size	Designates the memory size of the printer, in Mbytes. This is specified by the printer manufacturer.
Layouts tab	
Select the desired layouts allowed for this printer	Number and layout of images that may be printed on a single sheet of film or paper. Some selections control the orientation of the images on the page. For example, two images per page may be side by side, or one above the other.
Slide formats	Slide formats available for the printer, if any. Options are 35 or 40 mm.
Film Sizes tab Select the sizes of film available for this printer, and enter the pixel width (W) and pixel height (H). Pixel width and height values are provided by the printer manufacturer based on what the printer supports.	
Printer Settings tab	

Table 4-14 Add Printer screen parameter descriptions

Attribute	Value
# Of Copies	
Print Mode	
Magnification	
Format	
Orientation	
Media Type	
Destination	
Media Size	

6. Press SAVE.
7. Repeat this process for each printer the site wants to add.

4.4.2.2 Removing printers

Follow these instructions to remove a printer.

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, next to Network Connections, press EDIT.
3. On the Network Connections window, in the DICOM Printers section, select the printer connection to delete, and press REMOVE.

   A message appears: “Are you sure you want to remove (printer name)?”
4. Press YES to remove the printer connection.

Section 4.5 Image management

Image management parameters let the site control how images will be handled after acquisition, including printing, archiving, and deleting. For more information about image management parameters, including Auto Print, Auto Send (sometimes called Auto Push), and Auto Delete, refer to the Optima XR220amx or Optima XR200amx with digital upgrade Operator Manual.

Section 4.6 Image processing

4.6.1 Enabling EMI reduction

The EMI Reduction algorithm is designed to reduce artifacts resulting from electromagnetic interference from other equipment in the area during image acquisition.

Administrative users can enable or disable EMI reduction using the UTILITIES **>** PREFERENCES **>** IMAGE PROCESSING screen.

Contact a GE service representative to configure EMI reduction factors.

Section 4.7 Loading demo images

Load demo images from the CD-ROM provided with the system into the image database. This is applicable only to Optima XR220amx or Optima XR200amx with digital upgrade systems.

Refer to the Optima XR220amx Operator Manual's chapter on Image Management for more details.

4.7.1 Loading images from CD

Follow this process to access images stored on a CD.

1. Attach the external CD/DVD drive, and insert the disk with images into the CD/DVD drive.
2. On the Image Management screen, press Source CD1.
   The exam list is updated to show the images stored on the CD.
3. Select the exams to copy.
4. Copy the exams to the Local database.
5. Press the LOCAL Destination button.
   A message appears: "`Selected images will be copied to (destination name). Select OK to confirm.`"
6. Press OK.
7. Open the exams from the Local database.
   If the exams are being viewed on a computer that has the DICOM viewer installed, images may be viewed directly from the disk.

Section 4.8 Installing the Operator Manual

Optima XR220amx and Optima XR200amx with digital upgrade systems only.

To install the Operator Manual (OM), follow these steps:

1. Attach the external CD/DVD drive.
2. Exit all service applications, and close the SUIF.
3. Connect the service keyboard to a USB port.
4. Press these keys simultaneously:
   CTRL+ALT+F2
5. At the login prompt, type:
   `xruser`
   Press **ENTER**.
6. Enter the password:
   `4$xray`
   Press **ENTER**.
7. Insert the Operator Manual CD into the external CD/DVD drive.
8. To run the interactive script, at the prompt, type:
   `./xrdinstall.om`
   Press **ENTER**.
9. At the prompt, type **Y.**
10. Type the number of the language to install, then press **ENTER**.

11. When the installation is complete, at the prompt, type:

    `exit`

    Press **ENTER**.
12. To return to the applications screen, at the login prompt, press these keys simultaneously:

    CTRL+ALT+F7

Section 4.9 Login and user management

System administrators can perform a number of tasks that affect what users can do or will see. The administrative options are described in the Optima XR200amx or Optima XR220amx Operator Manual, Appendix A Login Administration.

Section 4.10 Installing hardware options

4.10.1 Installing the barcode reader

Applies to Optima XR220amx or Optima XR200 with digital upgrade systems only

Unpack the OPI-4002 barcode reader and associated components.

Note: The USB cable is packaged and shipped in a separate box than the barcode reader assembly.

4.10.1.1 Installing the barcode reader receiver

1. Plug the USB cable into the barcode reader receiver. See Figure 4-1.

Note: If the position of the label makes the barcode unreadable, move the label so the barcode can be read. A sample label similar to the one on the USB receiver is shown in Figure 4-1 below.

Figure 4-1 Sample barcode label

2. Remove the system side covers and the top cover. See the System manual, Replacement Procedures, Top cover removal.
3. Remove the two screws from the inside of the left drive handle support, then remove the cover. See Figure 4-2.

Figure 4-2 Left drive handle screws and cover

4. Route the USB cable through the opening in the bottom of the left drive handle support. See Figure 4-3.

   Note: You may need to loosen the detector bin mounting screws to provide clearance for routing the cable.

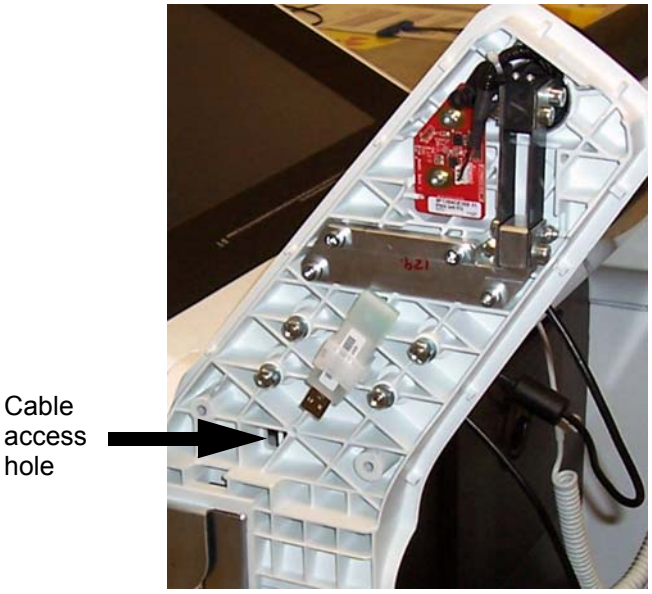
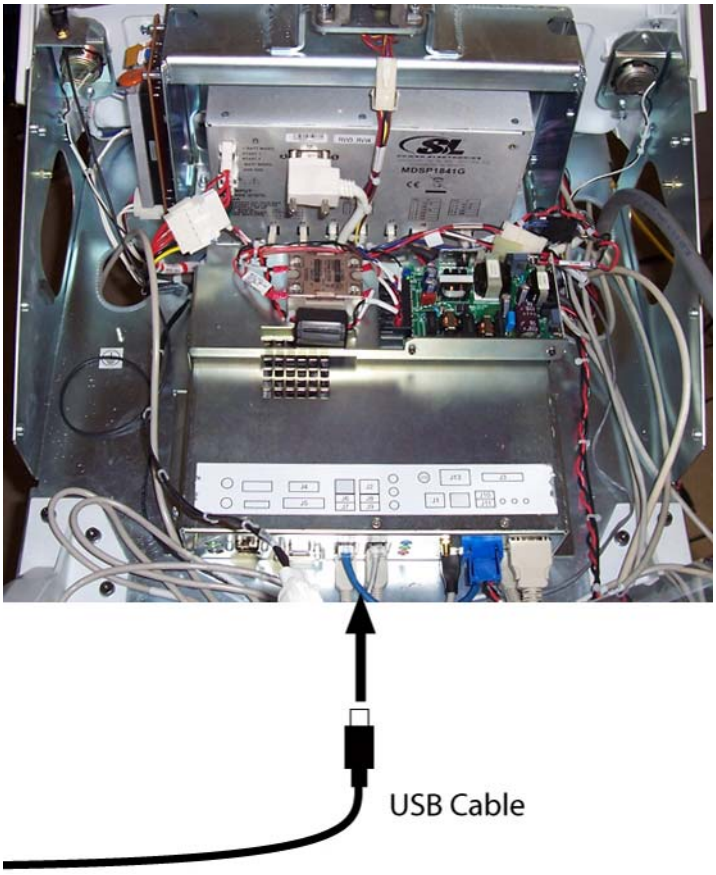


Figure 4-3 Cable access hole and receiver placement on system

5. Attach the USB receiver to the plastic clip with the barcode facing out as shown in Figure 4-3.

6. Plug the USB cable into a USB port on the PC. See Figure 4-4.



Item	Description
1	Host PC
2	Detector power supply (Optima XR220amx and Optima XR200amx with digital upgrade only)

Figure 4-4 Connect USB cable to PC

The Windows standard device driver will be installed automatically when you connect the barcode reader receiver to the USB port and the system is powered up.

During initialization, the LED is orange. When the receiver LED turns green, the initialization is complete and a connection has been made.

4.10.1.2 Connecting the barcode reader

1. Turn on system power.
2. Verify that the USB receiver is connected and that the green LED is blinking.
3. On the barcode reader, press the trigger key to start scanning.
4. Scan the barcode label on the USB receiver (Figure 4-1) to register the barcode reader.

   The connection is complete and the barcode reader is ready for use.

   Do not replace the covers at this point. You will need to scan the barcode receiver label during configuration.

5. Each time the system is rebooted, a message saying, "Do you want to connect to a bluetooth SPP?" appears. The user needs to select YES or the barcode reader functionality will not be enabled.

4.10.1.3 Barcode reader LED indicators

By default, the OPI-4002 scanner is in power saving mode. To turn it on, press the trigger key for a few seconds. If the scanner is not in use for a while, it will go into sleep mode and the trigger key must be pressed for a few seconds to reactivate the unit before scanning.

The table below lists the state of the scanner based on the scanner LEDs.

Table 4-15 LED indicator state

Color	Description
Green	Barcode was successfully read.
Red Blinking	Data transmission error. The battery may need to be charged.
Red Solid	Charging on the cradle. The LED changes from red to green when the battery is fully charged.

4.10.1.4 Charging the barcode reader

The barcode reader will not start up if the battery is empty. Use the charging cradle to charge the battery. It takes about three hours to fully charge a battery. Adapters are provided to connect the AC/DC converter to various power outlet configurations.

Figure 4-5 OPI-4002 barcode reader charging cradle and power adapters

4.10.2 Configuring the barcode reader

Applies to Optima XR220amx or Optima XR200 with digital upgrade systems only

The following section provides instructions for the default configuration and two optional settings. Have a printed copy of these pages on hand so you can scan the necessary barcodes. Refer to the OPI-4002 User's Guide for additional configuration options.

4.10.2.1 Setting to default configuration

1. Turn on the system. Wait until the green LED on the barcode reader receiver starts flashing.
2. Press the barcode reader trigger to start the scan.
3. Scan the Reset To Default barcode.

Figure 4-6 Reset to Default barcode

You will hear three quick sets of high-low-high beeps.

Whenever you scan the Reset To Default barcode, rescan the barcode label (on the barcode reader receiver) and re-program any optional configuration.

4. Scan the barcode label (Figure 4-1) on the barcode reader receiver to register the barcode reader.

   You will hear one set of high-low beeps, a short pause, and then one long high beep.

   The connection is complete and the barcode reader is ready for verification.

4.10.2.2 Verifying the default configuration

1. Turn on the system. Wait until the login screen appears.
2. Verify that a green LED is blinking on the barcode reader receiver.
3. Scan any barcode.

   You will hear one set of high-low beeps. The scanned barcode characters appear in the Login ID field on the login screen, and the cursor remains at the end of the scanned barcode.

   The configuration is successful and the barcode reader is ready for use.
4. Replace the system covers.

4.10.2.3 Optional configuration 1

Optional configuration 1 is to add a Tab at the end instead of Return.

This configuration sets the barcode reader to add a Tab at the end of the scan instead of a Return. Have a printed copy of these pages on hand so you can scan the necessary barcodes. If you make a mistake during this configuration, start over at step 1.

1. Power up the system. Wait until the green LED on the receiver starts flashing.
2. Perform 4.10.2.1 Setting to default configuration on page 72.
3. Scan the barcodes shown in Figure 4-7, top to bottom.

   After scanning each barcode you will hear one set of high-low-high beeps. The scanner will beep at a one-second interval, and the LED will alternate green and red.

   After scanning the last barcode, the scanner beam will turn off.

SET

RZ

TAB

END

Figure 4-7 Set Tab at the end instead of Return

4.10.2.4 Verifying optional configuration 1

1. Turn on the system. Wait until the login screen appears.
2. Verify that a green LED is blinking on the barcode reader receiver.
3. Scan any barcode.

   You will hear one set of high-low beeps. The scanned barcode characters appear in the Login ID field on the login screen, and the cursor moves to the Password field.

   The configuration is successful and the barcode reader is ready for use.
4. Replace the system covers.

4.10.2.5 Optional configuration 2

Optional configuration 2 is to strip first two and last four characters, and add a Tab suffix.

This configuration sets the barcode reader to strip the first two and last four characters, and add a Tab at the end of the scan. Have a printed copy of these pages on hand so you can scan the necessary barcodes. If you make a mistake during this configuration, start over at step 1.

1. Power up the system. Wait until the green LED on the receiver starts flashing.
2. Perform 4.10.2.2 Verifying the default configuration on page 72.
3. Scan the barcode shown in Figure 4-8.

   After scanning the barcode you will hear three sets of high-low-high beeps.

Figure 4-8 Strip first two and last four characters, and add a Tab suffix

4.10.2.6 Verifying optional configuration 2

1. Turn on the system. Wait until the login screen appears.
2. Verify that a green LED is blinking on the barcode reader receiver.
3. Scan any barcode.

   You will hear one set of high-low beeps. The scanned barcode characters appear in the Login ID field on the login screen, with the first two and last four characters stripped. The cursor moves to the Password field.

The configuration is successful and the barcode reader is ready for use.

4. Replace the system covers.

4.10.3 Installing the Dose Area Product (DAP) meter

4.10.3.1 DAP installation for Optima XR220amx system

1. Shut down the system and turn off the main circuit breaker.
2. Unpack the DAP meter.
3. Slide the meter into the lower set of collimator rails (the set further from the collimator). The meter must be installed with the cable exiting toward the rear.
4. Connect the DAP cable to the existing connector in the cable drape. See Figure 4-9.

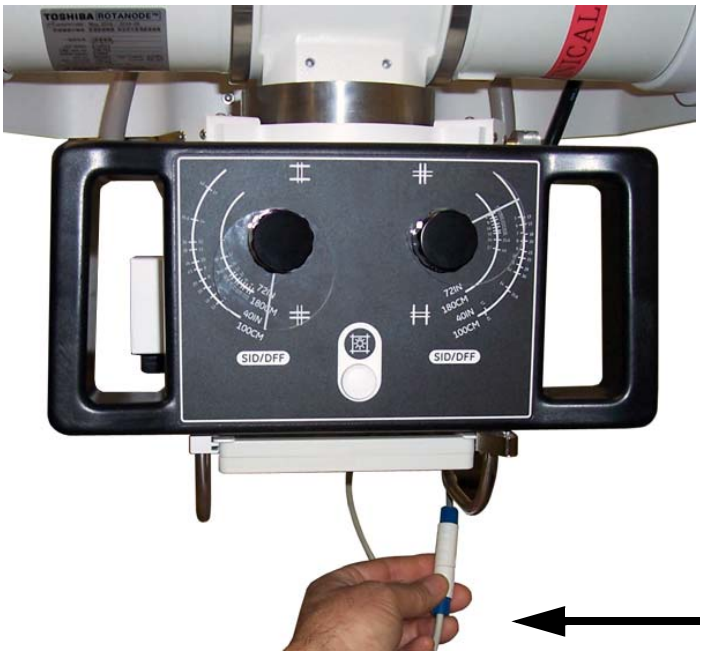


Figure 4-9 DAP meter cable attached

5. For Optima XR220amx systems, the DAP meter option is a standard option and has already been enabled. It can be turned on/off at the Applications level.

   a. On the Applications desktop, click the UTILITIES button.
   b. On the Utilities desktop, select PREFERENCES > OPTIONS.
   c. Turn the DAP function ON.
   d. Refer to the system Operator Manual for instructions on DAP usage.

NOTICE

Notice: The system must be reset using the power button each time the DAP meter is disconnected and then reconnected with system power on. The DAP meter does not support "Hot Swapping". Failure to reset the system in this occurrence can result in an inaccurate dose value reported by the DAP meter.

6. Perform DAP calibration. See 5.6.3 DAP calibration on page 94 for calibration procedure.

4.10.3.2 DAP installation for Optima XR200amx system

1. Shut down the system and turn off the main circuit breaker.
2. Remove the side covers, top cover and front bin. See the System manual, Replacement Procedures chapter, Front Bin Removal section.
3. Unpack the DAP meter and cable.
4. Slide the meter into the lower set of collimator rails (the set further from the collimator).The meter must be installed with the cable exiting toward the rear.
5. Install the DAP cable:
   a. Connect the round cable connector to the DAP meter. See Figure 4-10.

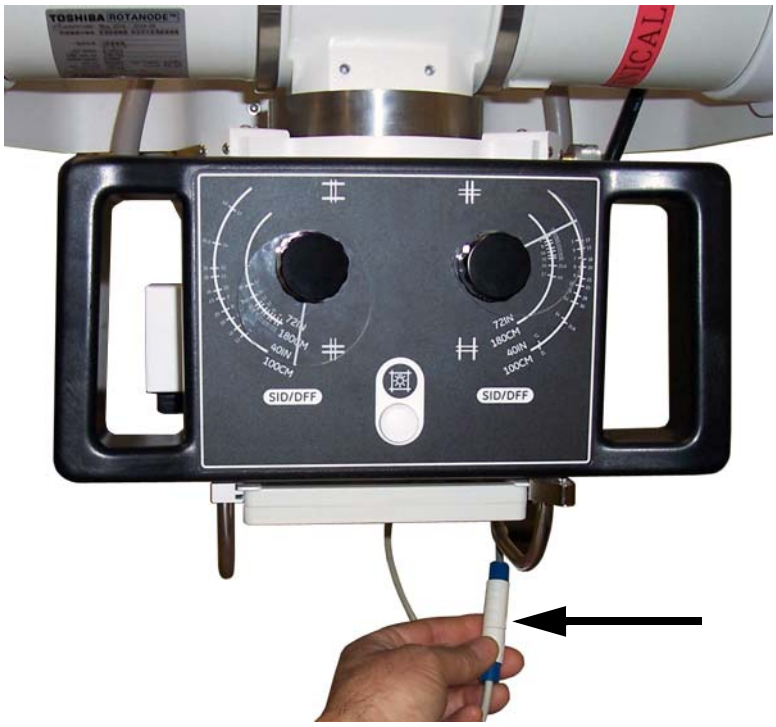
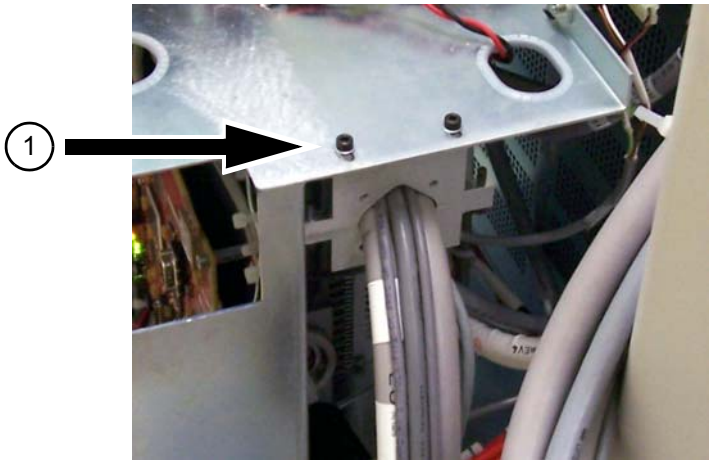


Figure 4-10 DAP meter cable attached

   b. Route the long DAP cable through the cable drape along the horizontal arm and vertical column.
   Loosely attach cable ties to hold the cable in position, but do not tighten them until range of motion is confirmed.
   Leave enough extra cable length at the DAP meter so that the tube/collimator assembly can be moved through the normal range of motion without unplugging the cable.
   c. Route the DAP cable through the cable access opening in the right-front cover. See Figure 4-11.
   d. Remove the HV cable clamp mounting screws. See Figure 4-11.



Item	Description
1	HV cable clamp mounting screws (2)

Figure 4-11 HV cable clamp mounting screws

e. Remove the clamp from the HV cable bundle. See Figure 4-12.

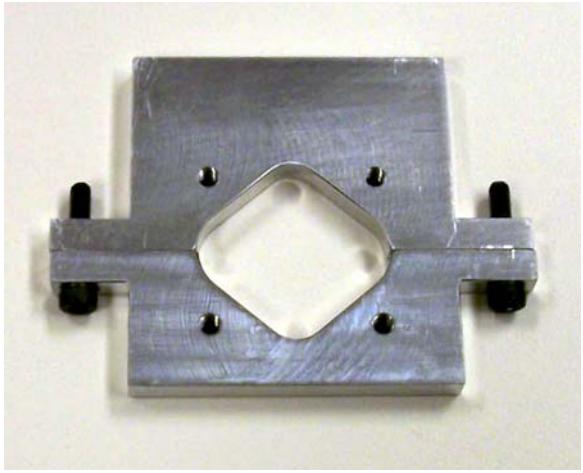


Figure 4-12 HV cable clamp

f. Plug the other end of the DAP cable into the J6 bulkhead connector. See Figure 4-13. Install cable ties as necessary to secure cable within the bulkhead area.

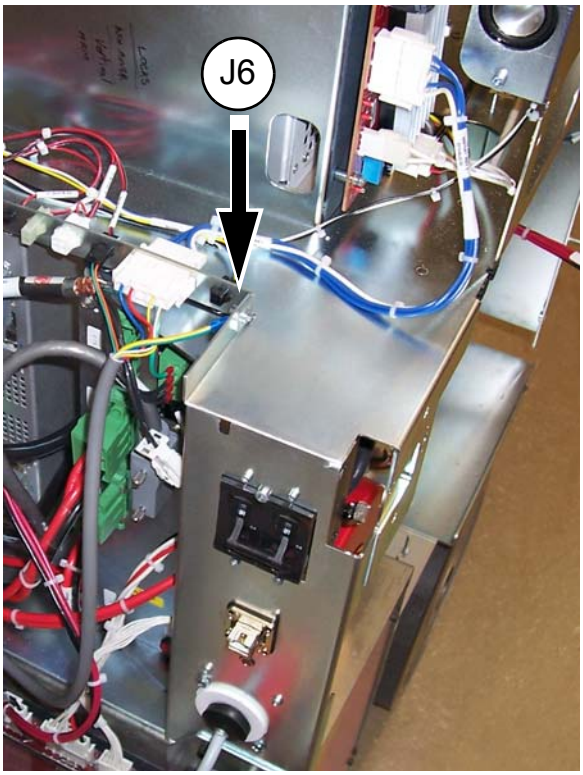
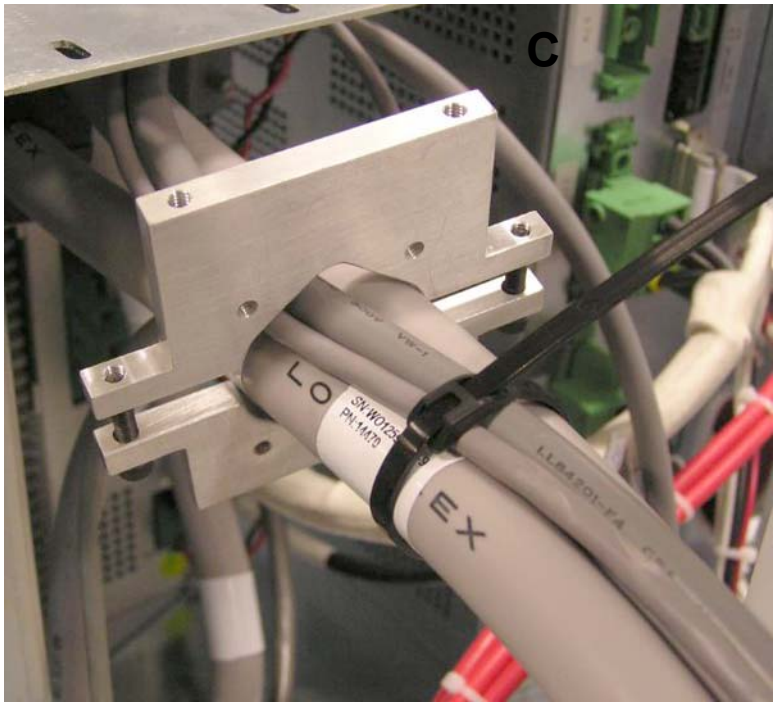
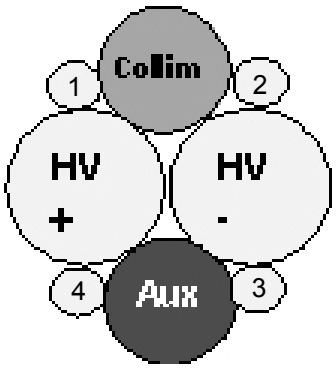


Figure 4-13 DAP meter cable attached to J6 on bulkhead

6. Confirm that there is sufficient slack in the DAP cable at the tube/collimator assembly:
   a. Move the tube/collimator assembly through the full range of motion and verify that the DAP cable remains connected to the DAP meter.
   b. Once sufficient cable slack is confirmed, tighten down the cable ties to secure the DAP cable to the existing cable drape.
7. Arrange the cable bundle as shown in Figure 4-14, use a cable tie to maintain cable positions.
8. Install the clamp onto the cable bundle. DO NOT TIGHTEN THE CLAMP YET.
9. Mount the clamp to the Thorax chassis. Slide the clamp to the rear of the mounting screw slots.
10. Tighten the clamp around the cable bundle, ensuring that the cables are not pinched by the clamp.





Item	Description
1	DAP cable (optional for Optima XR200amx systems)
2	Wireless cable (only valid for Optima XR220amx systems)
3	Vertical brake cable
4	Horizontal arm lock cable

Figure 4-14 Correct cable bundle arrangement

11. Install the front bin, top cover and side covers.
12. Configure the system to enable the DAP meter option. See 4.2.7 Options configuration on page 57.
13. Once the DAP meter option has been enabled, it must be 'switched on' at the Applications level:

    a. On the Applications desktop, click the UTILITIES button.
    b. On the Utilities desktop, select PREFERENCES > OPTIONS.
    c. Turn the DAP function ON.
    d. Refer to the system Operator Manual for instructions on DAP usage.

NOTICE

The system must be reset using the power button each time the DAP meter is disconnected and then reconnected with system power on. The DAP meter does not support "Hot Swapping". Failure to reset the system in this occurrence can result in an inaccurate dose value reported by the DAP meter.

14. Perform DAP calibration. See 5.6.3 DAP calibration on page 94 for calibration procedure.

Section 4.11 Importing custom IP looks from Definium AMX 700

Use the following procedure to back up customized image processing (IP) looks from an Definium AMX 700 system, and restore them on an Optima XR220amx system or Optima XR200amx with digital upgrade.

1. Make a system backup on the Definium AMX 700 system.
2. On the Optima system, exit the SUIF if it is open.
3. Insert the Definium AMX 700 system backup CD into the external CD/DVD drive of the system.
4. Press **CTRL + SHIFT + F5** to open the Engineering User Interface.
5. On the Engineering User Interface, press the TERMINAL icon.
6. At the command prompt, type:
   `mount /media/cdrecorder`
   Press **ENTER**.
   `cd /magichome/xruser/config/restore/`
   Press **ENTER**.
7. At the prompt, type:
   `chmod 777 restoreCustomIPLooks_F2toF3.sh`
   Press **ENTER**.
8. At the prompt, type:
   `./restoreCustomIPLooks_F2toF3.sh`
   Press **ENTER**. The script takes approximately 20 minutes to run. When completed, the system returns to the prompt.
9. At the prompt, type:
   `umount /media/cdrecorder`
   Press **ENTER**.
10. Remove the Definium AMX 700 backup media from the CD/DVD drive and disconnect the drive from the system.
11. Type `exit` to close the terminal window.
12. Exit the Engineering User Interface.
13. Reset the system.

Section 4.12 Enabling Advanced Service mode

Advanced Service (sometimes called “in-house service” or “extended service”) is available to customers that have purchased an Advanced Service package license from GE Healthcare.

Contact a GE service representative to enable Advanced Service.

Advanced Service provides the following functionality:

- SUIF in Advanced Service mode
- Detailed error descriptions in the Service Error Log Viewer
- Advanced diagnostics
- Extended error log with filtering

The following functionality is never included in an Advanced Service license:

- InSite ExC configuration
- Advanced service configuration or entitlement
- Purchased options configuration

Section 4.13 IP Address Change Procedure

The system uses IP Addresses 192.168.x.x for communication between the PC and the detectors. If the hospital network to the PC is also 192.168.x.x, issues will occur. Perform the following instructions to change the default internal IP Address if an IP Address conflict occurs with the hospital network.

1. Plug in the Service Keyboard.
2. Open a terminal window using **CTRL+SHIFT+F5** and click on the terminal window icon.
3. Change users by entering the following text at the prompt:

   su

   #superxr
4. Run the Change IP script by entering the following text at the prompt:

   /magichome/xruser/engg/changeIp.sh
5. Select 1 of the 5 options of subnet IP addresses. Write down the IP Address you select, you will need this in a later step.
   1. 172.16.x.x
   2. 172.17.x.x
   3. 172.18.x.x
   4. 192.168.x.x (SW LFC default)
   5. 192.169.x.x
6. The PC will reboot automatically, select SHUTDOWN when the system presents the Degraded mode screen.
7. Login to system.
8. Open a terminal window and become root
   `xruser@magic: su`
   `Password: #superxr`

   At prompt, type: **`ifconfig | more`**
   Confirm the br0 IP Address is **XXX.XXX.3.1** (where **XXX.XXX** equals the address range selected above).
9. To test network connectivity, perform a C-Echo test to one or more of the Network Hosts.
10. This step applies to Optima XR220amx or Optima XR200amx with Digital Upgrade only. Verify that all connected detectors boot successfully. Verify that you can take an exposure on all available receptors.
11. This step applies to Optima XR220amx or Optima XR200amx with Digital Upgrade only. Verify the Detector Wireless connection is active by acquiring an image.
12. Perform the Snapshot Tool Configuration.

4.13.1 Snapshot Tool Configuration

To ensure that the Auto-Snapshot Tool works after changing the IP Address.

1. Open a terminal window using **CTRL+SHIFT+F5** and click on the terminal window icon.
2. Switch to root by entering the following text at the prompt:

   su

   #superxr
3. Open Firefox Browser by typing the following command :

   firefox http://localhost/snapshot/Manual_Snapshot.html
4. Click on SNAPSHOT PREFERENCES. See Figure 4-15.

Figure 4-15 Snapshot Preferences

5. Repeat Steps 6 through 17 (below) for the following four Configurations (available under the drop-down menu):
   * Asnapshot_Lightning
   * ASnapshot_BKP
   * Snapshot_ResetTimeOut
   * QuickSnapshot

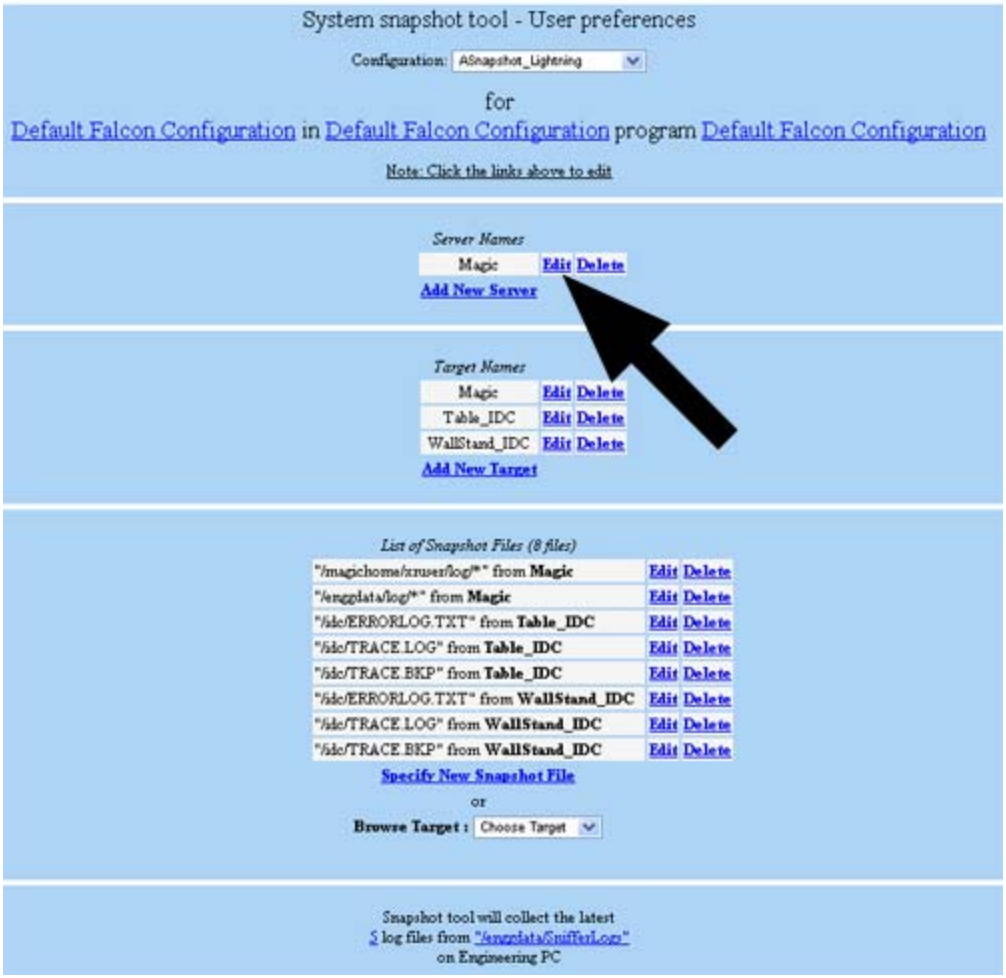
6. In the Configuration drop-down menu, select ASNAPSHOT_LIGHTNING. See Figure 4-16.

Figure 4-16 Select Configuration

System snapshot tool - User preferences
Configuration: *EMPTY*
for
Enter cell name in Enter pole name program Enter program name
Note: Click the links above to edit
No Servers Specified yet
Add New Server
No Targets Specified yet!
Add New Target
There are no files in the Snapshot
Specify New Snapshot File
or
Browse Target : Choose Target
Snapshot tool will collect the latest
0 log files from "Enter a correct path to sniffer files"
on Engineering PC

6. In Server Names section, click on EDIT. See Figure 4-17.

Figure 4-17 Edit Server Name - Magic


System snapshot tool - User preferences
Configuration: ASnapshot_Lightning
for
Default Falcon Configuration in Default Falcon Configuration program Default Falcon Configuration
Note: Click the links above to edit
Server Names
Magic Edit Delete
Add New Server
Target Names
Magic Edit Delete
Table_IDC Edit Delete
WallStand_IDC Edit Delete
Add New Target
List of Snapshot Files (8 files)
"/magichome/xruser/log/*" from Magic Edit Delete
"/enggdata/log/*" from Magic Edit Delete
"/idc/ERRORLOG.TXT" from Table_IDC Edit Delete
"/idc/TRACE.LOG" from Table_IDC Edit Delete
"/idc/TRACE.BKP" from Table_IDC Edit Delete
"/idc/ERRORLOG.TXT" from WallStand_IDC Edit Delete
"/idc/TRACE.LOG" from WallStand_IDC Edit Delete
"/idc/TRACE.BKP" from WallStand_IDC Edit Delete
Specify New Snapshot File
or
Browse Target : Choose Target
Snapshot tool will collect the latest
5 log files from "/enggdata/SnifferLogs"
on Engineering PC

7. In the IP Address data entry text box, change 192.168.3.1 to “xxx.xxx.3.1” (where xxx.xxx.3.1 is the same IP Address range used in Section 4.13 IP Address Change Procedure and 3.1 is the specific address assignment for the host pc port). See Figure 4-18.

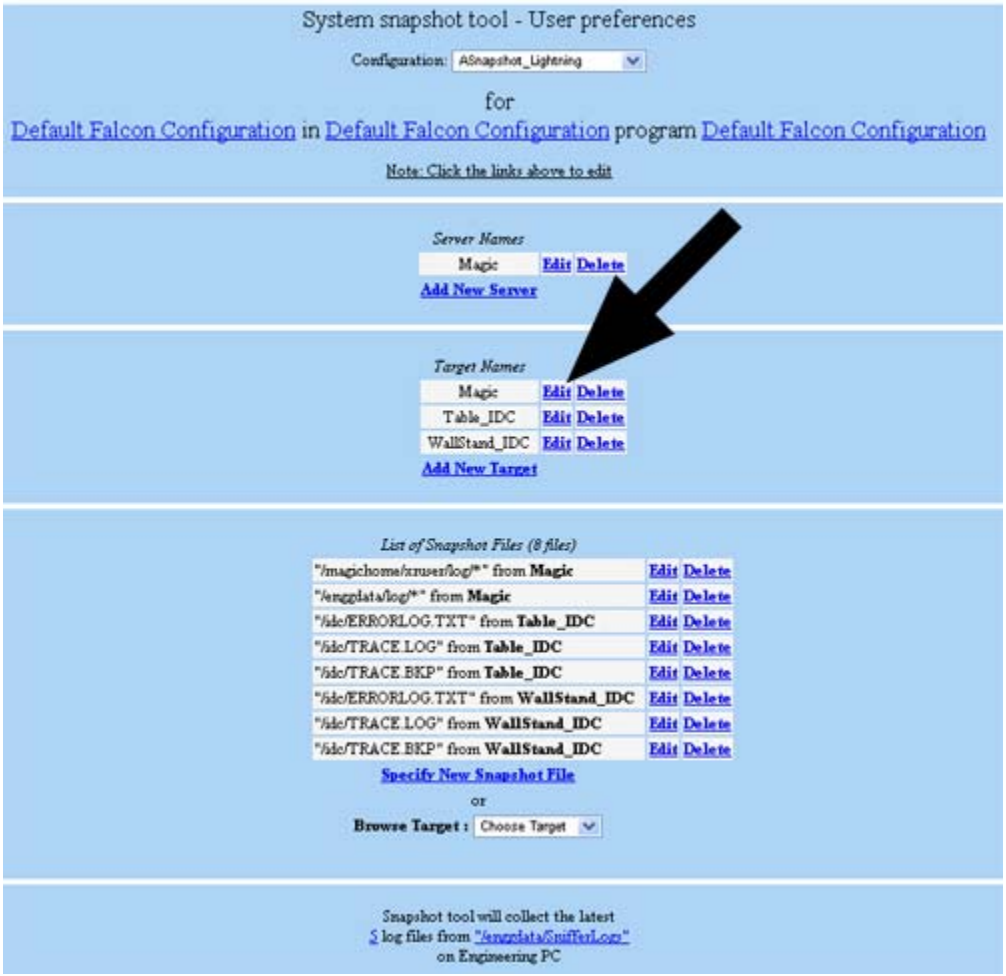
Figure 4-18 Change IP Address

8. Click on SUBMIT. See Figure 4-19.

Figure 4-19 Submit New IP Address

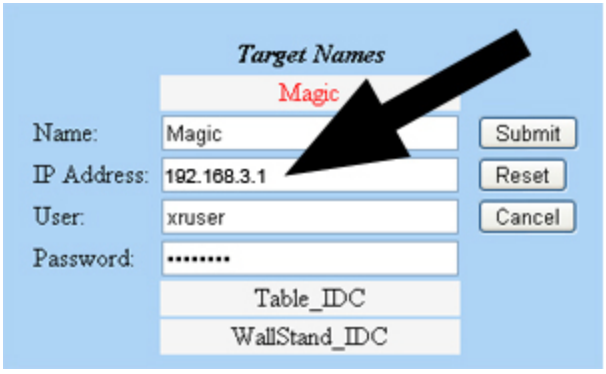
9. Under Target Names - Magic, click EDIT. See Figure 4-20.

Figure 4-20 Edit Magic Target Name


System snapshot tool - User preferences
Configuration: ASnapshot_Lightning
for
Default Falcon Configuration in Default Falcon Configuration program Default Falcon Configuration
Note: Click the links above to edit
Server Names
Magic Edit Delete
Add New Server
Target Names
Magic Edit Delete
Table_IDC Edit Delete
WallStand_IDC Edit Delete
Add New Target
List of Snapshot Files (8 files)
"/magichome/xruser/log/*" from Magic Edit Delete
"/enggdata/log/*" from Magic Edit Delete
"/ide/ERRORLOG.TXT" from Table_IDC Edit Delete
"/ide/TRACE.LOG" from Table_IDC Edit Delete
"/ide/TRACE.BKP" from Table_IDC Edit Delete
"/ide/ERRORLOG.TXT" from WallStand_IDC Edit Delete
"/ide/TRACE.LOG" from WallStand_IDC Edit Delete
"/ide/TRACE.BKP" from WallStand_IDC Edit Delete
Specify New Snapshot File
or
Browse Target : Choose Target
Snapshot tool will collect the latest
5 log files from "/enggdata/SniffErrLogs"
on Engineering PC

10. In the IP Address data entry text box, change 192.168.3.1 to “xxx.xxx.3.1” (where xxx.xxx.3.1 is the same IP Address range used in Section 4.13 IP Address Change Procedure and 3.1 is the specific address assignment for the host pc port). See Figure 4-21.

Figure 4-21 Edit Magic IP Address



11. Click on SUBMIT. See Figure 4-22.

Figure 4-22 Submit New Magic IP Address

12. Back on Snapshot Preferences main screen, click on Target Names – Table_IDC – DELETE. See Figure 4-23.

Figure 4-23 Delete Target Name "Table_IDC"

System snapshot tool - User preferences
Configuration: ASnapshot_Lightning
for
Default Falcon Configuration in Default Falcon Configuration program Default Falcon Configuration
Note: Click the links above to edit
Server Names
Magic Edit Delete
Add New Server
Target Names
Magic Edit Delete
Table_IDC Edit Delete
WallStand_IDC Edit Delete
Add New Target
List of Snapshot Files (8 files)
"/magichome/xruser/log/*" from Magic Edit Delete
"/engpiata/log/*" from Magic Edit Delete
"/idc/ERRORLOG.TXT" from Table_IDC Edit Delete
"/idc/TRACE.LOG" from Table_IDC Edit Delete
"/idc/TRACE.BKP" from Table_IDC Edit Delete
"/idc/ERRORLOG.TXT" from WallStand_IDC Edit Delete
"/idc/TRACE.LOG" from WallStand_IDC Edit Delete
"/idc/TRACE.BKP" from WallStand_IDC Edit Delete
Specify New Snapshot File
or
Browse Target : Choose Target
Snapshot tool will collect the latest
5 log files from "/engpiata/SnifferLogs"
on Engineering PC

13. You will get a popup like below, select OK. See Figure 4-24.

Figure 4-24 Table_IDC Popup Message

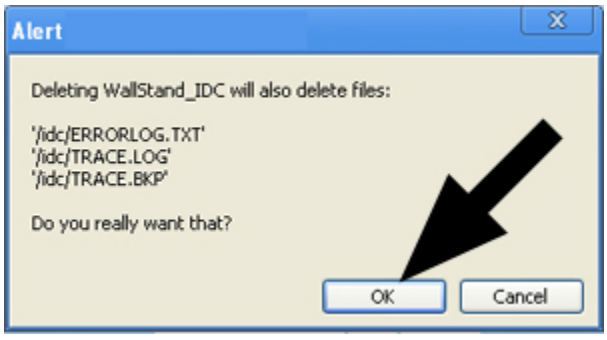
14. Under Target Names – WallStand_IDC click on DELETE. See Figure 4-25.

Figure 4-25 Delete Target Name "WallStand_IDC"

System snapshot tool - User preferences
Configuration: ASnapshot_Lightning
for
Default Falcon Configuration in Default Falcon Configuration program Default Falcon Configuration
Note: Click the links above to edit
Server Names
Magic Edit Delete
Add New Server
Target Names
Magic Edit Delete
Table_IDC Edit Delete
WallStand_IDC Edit Delete
Add New Target
List of Snapshot Files (8 files)
"/magichome/xruser/log/*" from Magic Edit Delete
"/enggdata/log/*" from Magic Edit Delete
"/idc/ERRORLOG.TXT" from Table_IDC Edit Delete
"/idc/TRACE.LOG" from Table_IDC Edit Delete
"/idc/TRACE.BKP" from Table_IDC Edit Delete
"/idc/ERRORLOG.TXT" from WallStand_IDC Edit Delete
"/idc/TRACE.LOG" from WallStand_IDC Edit Delete
"/idc/TRACE.BKP" from WallStand_IDC Edit Delete
Specify New Snapshot File
or
Browse Target : Choose Target
Snapshot tool will collect the latest
5 log files from "/enggdata/SnifferLogs"
on Engineering PC

15. You will get a popup like below, select OK. See Figure 4-26.

Figure 4-26 WallStand_IDC Popup Message



16. Under Manage Preferences section, click on SAVE AS.... See Figure 4-27.

Figure 4-27 Save Changes

17. Go to Step 5 until all four configurations are completed.
18. Press **CTRL+F4** at the same time to close the html interface.
19. Success Check Steps:

    If everything is fine you should be able to see Auto Snapshots getting generated after reset:

    a. Perform a system reset.
    b. After system is booted up, login and wait for 5 minutes.
    (Snapshot is being created in a temp location)
    c. While you are waiting, open a terminal window using **CTRL+SHIFT+F5** and click on the terminal window icon.
    d. Run following command:

    ```
    ls –ltr /enggdata/Snapshots/*3400017*.zip
    ```

    e. Note the date/time stamp of the most recently created file.
    f. After 5 minutes reset and reboot the system, login.
    (Snapshot from temp location is written to Snapshots directory and a new snapshot is being created in a temp location)
    g. Open a terminal window using **CTRL+SHIFT+F5** and click on the terminal window icon.
    h. Run following command:

    ```
    ls –ltr /enggdata/Snapshots/*3400017*.zip
    ```

    i. The output of (c) above should show a snapshot file, having the string 3400017 embedded in the snapshot filename, created after the most recent system boot (in Step b above).
    j. Type **date** to see the current system time.
    The latest snapshot file should have been created a few minutes before the date command output.
    k. Verify the file size is greater than 400,000:
    `-rw-rw-r- - 1 xruser xruser` **`file size`** `date time /path/filename`

20. Close all windows.
21. Complete all system configurations and customer settings.
22. Create a new System Backup on DVD media.
    Note: Do not use backup media from any other system. The result will be that half of the system is configured for 172.x.x.x and other half is configured for 192.x.x.x
    The system will then boot into Degraded Mode only.
    Also, when performing a Software Load, you must perform this procedure first before doing a System Restore.

Chapter 5 Calibration

Section 5.1 Preparing for calibrations

This chapter explains how to calibrate the detector, printer, touchscreen, drive subsystem, and elements of the generator. It also covers how to determine the appropriate burn configuration for PACS images.

NOTICE

FOLLOW PROCEDURES
Important! Perform the calibrations in the order shown in the left frame of the Calibration screen on the Service User Interface (SUIF).
While working in the SUIF, watch the status bar and wait for activities to complete before starting the next step. Look for messages like "Ready..." or "Ready for input."

5.1.1 Saving changes

After changing, creating, or restoring calibration files, be sure to reboot the system so that the application software can detect the file changes.

After completing the steps in this chapter, save the changes by performing a system backup. See Chapter 3 System data and software in the Optima XR200amx/XR220amx System Manual for the backup procedure.

Section 5.2 Touchscreen calibration

5.2.1 Calibrating the touchscreen

Follow this procedure to set the active area of the touchscreen and align it to the underlying video application to ensure accurate measurement.

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, press LAUNCH.
3. On the SUIF home page, press the CALIBRATION tab button.
4. On the Calibration page, in the left folder tree, select TOUCHSCREEN.
5. Press START and follow the on-screen instructions.
6. The touchscreen calibration utility prompts you to touch a cross-hair icon in a series of nine locations. Afterward, you can press ACCEPT to write the settings to the calibration config file, or CANCEL to discard the settings.

   When the cross-hair appears, you have 10 seconds to respond. A countdown timer is displayed. If you do not respond within 10 seconds, the calibration is aborted.

After you touch all the calibration points, you have 90 seconds to verify pointer accuracy before accepting the changes. A countdown timer is displayed. If you do not respond within 90 seconds, calibration is aborted.

Important! If the program aborts or you press CANCEL, the utility does not revert to the prior calibration; the touchscreen calibration is lost. The touchscreen accuracy may be very poor and require some effort to restart the calibration from the SUIF.

7. Press ACCEPT to write the settings to the calibration config file, or CANCEL to discard the settings.
8. Click on HARDWARE CALIBRATION and perform the TOUCHSCREEN CALIBRATION at the hardware level. See. 2.1.2 Touch screen calibration on page 6.

Section 5.3 Generator calibration

5.3.1 Setting filament drive level

⚠ CAUTION

EXPOSURE TO RADIATION
Employ X-ray safety practices to minimize exposure to radiation. Use portable shields or lead aprons. Aim the tube away from personnel. Adjust both lateral and transverse collimator blades to the minimum field size setting.

NOTICE

NO DETECTOR IN BEAM DURING CALIBRATION
Make sure there is no digital detector in the X-ray field at any time during this calibration.

This procedure automatically sets the initial filament drive levels for each X-ray tube focal spot.

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, press LAUNCH.
3. On the SUIF home page, press the CALIBRATION tab button.
4. On the Calibration page, in the left folder tree, select GENERATOR > FILAMENT DRIVE.
5. Press START and follow the on-screen instructions.

   The process is a sequence of 24 exposures: 9 for the small filament and 15 for the large. The system automatically sets the technique and selects the focal spot.

   Use the handswitch to initiate the prep and expose sequence. The handswitch must be fully released after each exposure.

   A display updates the completion status for each of the 24 exposures.

   After completing exposure 24, press COMPLETE to finalize the calibration.

5.3.2 Viewing and resetting tube and generator usage data

Use this procedure to display and store tube usage data that can be accessed to determine warranty coverage. Reset the data after replacing a tube.

Note: It is recommended that you record the current values prior to making any changes.

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, press LAUNCH.
   The Service Home tab is displayed. The Home tab contains summary information including site identification, connectivity parameters, and enabled options.
3. Press the CALIBRATION tab button.
4. On the Calibration page, in the left folder tree, select GENERATOR > TUBE WARRANTY.
5. Select RESET and follow the on-screen instructions.
6. Exit the SUIF and launch it again to see the reset values.

Section 5.4 Detector calibration

Detector calibrations apply only to Optima XR220amx or Optima XR200amx with digital upgrade systems.

For system operation, detector calibrations are not normally required as the detector contains a set of calibration files. Calibrations should only be performed if image quality issues warrant updating bad pixel maps and/or gain calibration files.

NOTICE

IMAGE QUALITY AFFECTED
Detector calibrations must be performed using the tether. Failure to use this process can result in calibration failures and/or image quality issues.

5.4.1 Executing bad pixel and gain calibrations

Use the Bad Pixel Calibration tool to detect defective pixels. Then use the Gain Calibration Tool to calibrate a gain coefficient for each pixel to achieve uniform gain across the detector. Perform these two calibrations in sequence.

Note: DO NOT change the exposure techniques for these calibrations. They are automatically set by the calibration software and are required for proper calibration.

5.4.1.1 Bad pixel calibration

This procedure calculates defective pixels from dark and X-ray images.

The detector must be connected via tether and stabilized for a minimum of 10 minutes. The 10 minute counter starts when the calibration is initiated.

Be sure that the correct firmware is downloaded to the detector before proceeding.

Bad pixel calibration is a multi-step process, including a QC test exposure and four additional exposures. The generator technique for each exposure is set automatically by the system.

CAUTION

EXPOSURE TO RADIATION
Employ X-ray safety practices to minimize exposure to radiation. Use portable shields or lead aprons. Aim the tube away from personnel.

1. Install the flat field phantom from the front of the collimator into the collimator rails as shown in Figure 5-1.

Figure 5-1 Flat field phantom

2. On the Applications desktop, press the UTILITIES button.
3. On the Utilities desktop, press LAUNCH.
4. On the SUIF home page, press the CALIBRATION tab button.
5. On the Calibration page, in the left folder tree, select DETECTOR > BAD PIXEL.
6. Press START and follow the on-screen instructions.

   Press and hold the Prep/Expose handswitch to make the exposures as directed. The handswitch must be released after each exposure. The X-ray tube must be positioned at 120cm SID, full FOV, beam centered on the detector.

5.4.1.2 Gain calibration

The bad pixel calibration (see 5.4.1.1 Bad pixel calibration on page 91) must be performed before starting the gain calibration.

This set of three calibration procedures (one each for 60, 80, and 120 kVp) creates gain maps used to compensate for gain non-uniformities. The flat field phantom is used only for the 80 and 120 kVp techniques. The X-ray tube must be positioned at 120 cm SID, full FOV, beam centered on the detector for this calibration.

⚠ CAUTION

EXPOSURE TO RADIATION
Employ X-ray safety practices to minimize exposure to radiation. Use portable shields or lead aprons. Aim the tube away from personnel.

1. On the Calibration page, in the left folder tree, select DETECTOR > GAIN.
2. Remove the flat field phantom from the collimator rails.
3. Select 60 KVP MAX DOSE.
4. Press START and follow the on-screen instructions.
5. Insert the phantom into the collimator rails.
6. Select 80 KVP MAX DOSE and 120 KVP MAX DOSE.
7. Press START and follow the on-screen instructions.
   a. On the entry page, choose one of the kV techniques, then select START to begin the calibration (or CANCEL to abort).
   b. Each process begins with a QC exposure to check for setup and alignment errors, followed by a sequence of 10 exposures. The generator technique for each exposure is set automatically by the system.
   c. Press and hold the Prep/Expose handswitch to make the exposures. Release the handswitch after each exposure. An exposure inhibit symbol appears in the status bar until the system is ready for the next exposure.
   d. After the last exposure, calculations are performed and the message "`Calibration completed successfully`" appears, along with instructions to select CANCEL to abort calibration or COMPLETE to save gain calibration data.
   e. After each kV technique, the program returns to the calibration summary page. Re-open the gain calibration page to verify that the date and pass/fail result for the calibration were properly updated, then continue by selecting the next technique and starting the calibration.
8. Reset the system after calibrations are completed.
9. Use the QAP tool to evaluate image quality and verify that it passes. Refer to the Installation Manual, Chapter 6 - Detector checks and QAP.

Section 5.5 Image quality calibration

Image quality calibrations apply only to Optima XR220amx or Optima XR200amx with digital upgrade systems.

5.5.1 Calibrating the printer

Follow this procedure to send grayscale output to the printer and to calculate compensation LUT (look up table) for compatibility.

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, press LAUNCH.

3. On the SUIF home page, press the CALIBRATION tab button.
4. On the Calibration page, in the left folder tree, select IMAGE QUALITY > PRINTER.
5. Press the CALIBRATION icon.
6. In the left frame, select IMAGE QUALITY > PRINTER.
7. Select the correct printer from the Printer Label drop-down list.
8. Press START and follow the on-screen instructions.

Section 5.6 Hardware calibration

5.6.1 Drive handle calibration

Follow this procedure to calibrate the drive handle and ensure accurate movement and steering.

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, press LAUNCH.
3. On the SUIF home page, press the CALIBRATION tab button.
4. On the Calibration page, in the left folder tree, select HARDWARE CALIBRATION **>** DRIVE HANDLE.
5. Follow the on-screen instructions.

5.6.2 Touch screen calibration

Follow this procedure to calibrate the touch screen. This calibration is needed for when the Spyder board has control of the display due to switch display functionality. This calibration is in addition to the SW touch screen calibration also found in the SUIF.

1. On the Applications desktop, press the UTILITIES button.
2. On the Utilities desktop, press LAUNCH.
3. On the SUIF home page, press the CALIBRATION tab button.
4. On the Calibration page, in the left folder tree, select HARDWARE CALIBRATION **>** TOUCH SCREEN.
5. Follow the on-screen instructions.

5.6.3 DAP calibration

5.6.3.1 Personnel Requirements

- Required persons: 1
- Timing (min): 30

5.6.3.2 Preliminary requirements

5.6.3.2.1 Tools and test equipment

- Dose meter with mR or uGy measurement units.

5.6.3.2.2 Consumables

- None

5.6.3.2.3 Safety

- Appropriate ionizing radiation PPE

5.6.3.2.4 Required Conditions

- DAP meter is connected.
- DAP meter is enabled in software.
- No DAP related errors in the system error log.
- DAP temperature stabilized to the operating environment.
- Wait 5 minutes after the DAP is connected and energized per the OEM for internal stabilization before calibration or clinical use.

5.6.3.3 Preface

The purpose of this calibration is to modify the correction factor stored in the DAP device. The DAP response is dependent upon temperature and atmospheric pressure.

A correction factor of 1 (no correction) is specified by the OEM of sea level elevation @ 20°C (68°F).

The DAP Calibration correction factor (CF) is stored in the DAP itself and not on the system. For this reason adhere to the following;

- Do not press COMMIT if you are exploring, entering random numbers and making exposures. This loads interim CF values into the DAP. Assume this value to be bad. By pressing CANCEL the original DAP resident CF value will be restored.
- Do not return the system to clinical use if the system shuts down in the middle of this calibration. The DAP will contain an interim CF value. Assume this value to be bad. Restore the system to proper working order and perform this calibration procedure. Make sure you press COMMIT to save the correct and valid CF value.
- A result of PASS is presented when the test meter and the DAP reported values have less than a 10% error.
  * At this point you can select COMMIT and the calibration is complete, or you can select CONTINUE and repeat in the attempt to reduce the PASS Error percentage. Do not expect to achieve a 0% error result. It is possible but not probable due to the variables of the X-ray beam and measurement devices.

5.6.3.4 Procedure

Prior to launching the DAP Calibration utility in the SUIF service interface the following set-up conditions must be followed.

⚠ CAUTION

Do not deviate from this instruction or randomly enter values into the DAP calibration utility. Failure to follow this instruction can result in grossly inaccurate Dose Value reporting during clinical system usage.

1. Place the imaging receptor on a platform at least 25 cm (10 in) above the floor to reduce back scatter. The imaging receptor should be parallel to the floor.
2. Make an exposure with the following parameters;

a. FOV = 10 cm x 10 cm (centered on imaging receptor)
b. SID = 100 cm
c. kV = 70
d. mAs = 100

3. Develop the image as necessary and make measurements accurately recording the FOV X and Y values (length and width)s
   a. For systems with a digital detector use the Image review measure distance tools.
   b. For all other imaging media make accurate manual measurements per OEM recommendations.
   c. The acceptable FOV range is as follows;
      * X = 80 mm to 120 mm
      * Y = 80 mm to 120 mm
   d. Make and record these measurements in millimeters. The DAP calibration utility will accept only metric values.
4. Replace the imaging receptor with the Dose meter probe.
   a. Using the field light, place the probe in the center of the FOV at the same plane as the imaging receptor.

⚠ CAUTION

Do not disturb the SID from this point on. Failure to follow this instruction can result in grossly inaccurate Dose Value reporting during clinical system usage.

5. Launch the DAP calibration utility as follows;
   a. On the Applications desktop, press the UTILITIES button.
   b. On the Utilities desktop press the Service LAUNCH button.
   c. On the SUIF home page press the CALIBRATION tab button.
   d. On the calibration page, in the left folder tree, press HARDWARE CALIBRATION.
   e. In the left navigation frame press HARDWARE and select DAP CALIBRATION.
6. Follow the On-Screen instructions.

Notes:

- Only valid X and Y values entered in millimeters will be accepted.
- Configure your dose meter to measure in either milli-Roentgen (mR) or micro-Grays (uGy).
- Select the appropriate unit of measure in the DAP calibration utility and enter the measured value when prompted.
  * A test meter dose reading of approximately 230mR is typical. However, it is dependent upon the actual FOV, SID, KV, mAs.
  * The system will present results in uGy units.

Section 5.7 PACS image tests

PACS image tests apply only to Optima XR220amx or Optima XR200amx with digital upgrade systems.

Follow these procedures to test image display characteristics and determine the burn configuration for PACS images for each destination host.

5.7.1 Comparing PACS test images

In the following tests, use the nine PACS test images to test image display characteristics and determine image display configuration.

Each PACS test image consists of two aspects:

- On the right, a clinical chest image with image number and GE logo watermark (Figure 5-2).
- On the left, a series of 12 vertical bands. The top six bands are dark and the bottom six are bright.

  Inside each band are five small squares with different intensities (like the 5%/95% squares in a SMPTE pattern). The squares provide a quantitative way to compare two images.

The pixel data in every test image is identical. Only the DICOM headers, annotations, and window center (WC) and window width (WW) values are slightly different for each pattern.

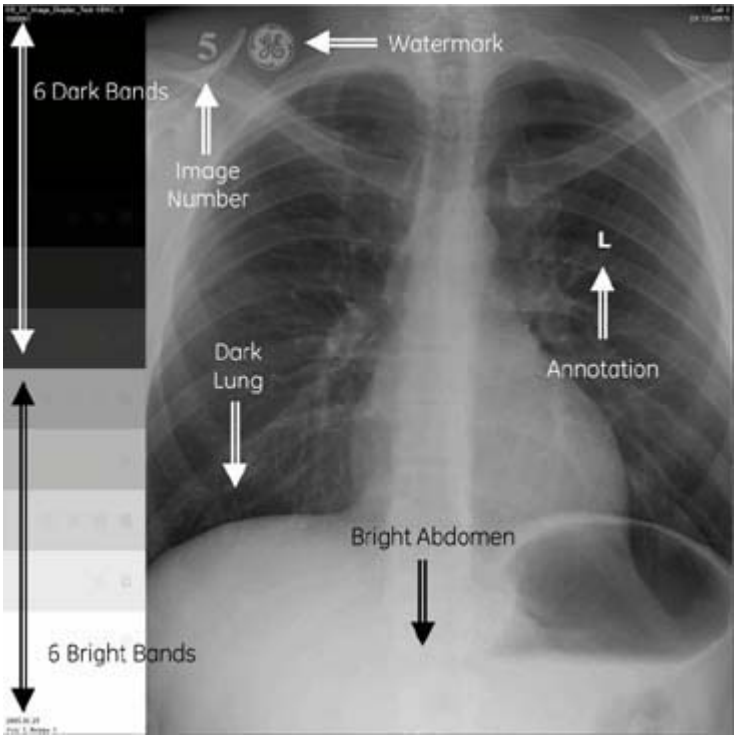


Figure 5-2 PACS/image display test image

5.7.2 Determining PACS burn/no-burn configuration

5.7.2.1 Verifying PACS monitor calibration

1. Verify that the PACS monitor is calibrated according to DICOM Standard Part 14. Each site is

responsible for providing evidence of PACS monitor calibration.

2. At the application desktop, press IMAGE TOOLS.
3. Click SMPTE to load the SMPTE pattern into the Patient List.
4. Send the SMPTE pattern to the PACS review workstation
5. Verify that 5% and 95% squares are equally visible on PACS (Figure 5-3).

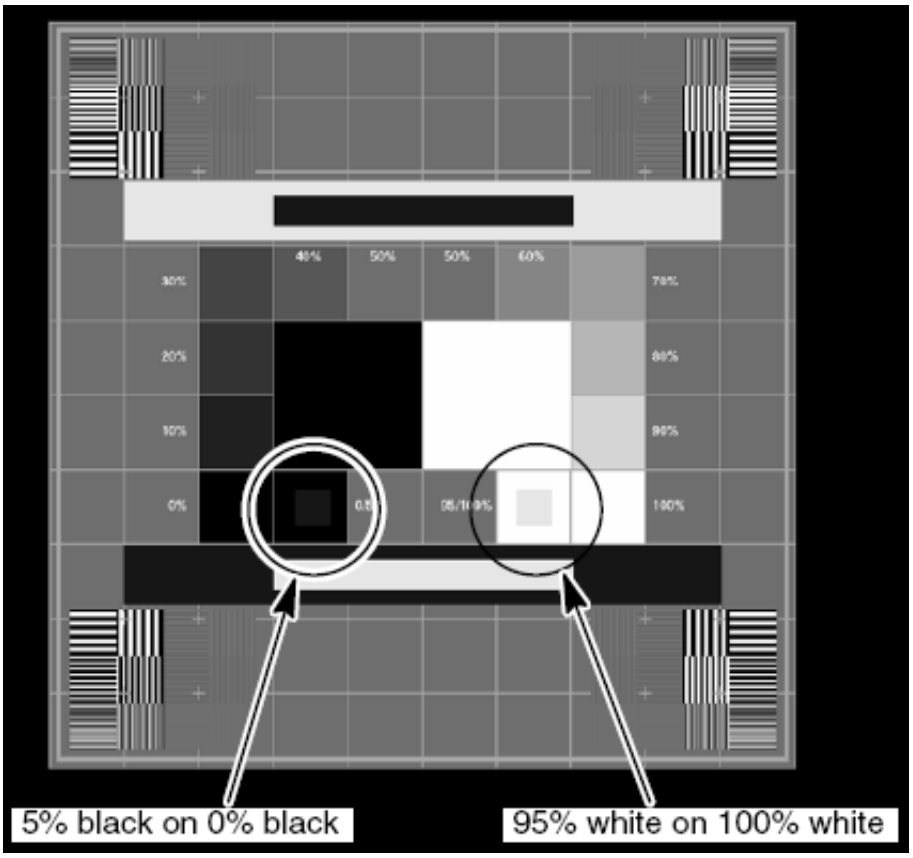


Figure 5-3 SMPTE pattern

5.7.2.2 Loading test images

1. Load the PACS test images onto the acquisition workstation. Use either:
   - A DICOM-formatted CD-ROM with images.
   - Images that are stored on the system in Image Tools.
2. Verify that the patient name is `GE_DX_Image_Display_Test, GEHC` and the patient ID is `2000002`.

5.7.2.3 Sending no-burn images to the PACS

1. In the SUIF, press the UTILITIES tab button.
2. Next to Network Connections, press EDIT.
3. Select the appropriate network host and press EDIT.
4. On the Preferences tab, verify that the following parameter is NOT checked:
   `Apply Burn-on-Send to images when sending to this network host.`
5. In the Images list, highlight `PACS Test Image #1`.

6. In the Destination icon list, press the appropriate PACS network host.

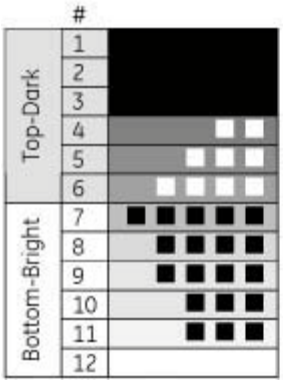
5.7.2.4 Sending burn-on-send images to the PACS

1. In the SUIF, press the UTILITIES tab button.
2. Next to Network Connections, press EDIT.
3. Select the appropriate network host and press EDIT.
4. On the Preferences tab, check `Apply Burn-on-Send to images when sending to this network host.`
5. In the Images list, highlight `PACS Test Image #6`.
6. In the Destination icon list, press the appropriate PACS network host.

5.7.2.5 Reviewing images on PACS

1. On the PACS review workstation, display PACS test images #1 and #6. To identify an image, look in the chest image region for the watermark image number next to the GE logo.
2. Verify that image #1 is displayed with a Value-of-Interest Look-Up Table (VOI-LUT).
3. Verify that image #6 is displayed with a Linear Look-Up Table (Linear LUT).
4. Compare PACS Test Images #1 and #6 and note the following items:
   a. The number of distinct bright and dark bands (based on the band intensity)
   b. The number of squares visible in each band

      Count bands that have distinct gray levels, not simply the number of bands with visible squares. For example, in Figure 5-4, there are two squares in band #4, three squares in band #5, and three squares in band #11. There are three distinct dark bands and six distinct bright bands. This is because the top three dark bands are indistinguishable.



	#	Distinct bands	Squares visible
Top-Dark	1	4	0
	2		0
	3		0
	4	3	2
	5	2	3
	6	1	4
Bottom-Bright	7	1	5
	8	2	4
	9	3	4
	10	4	3
	11	5	3
	12	6	0

Figure 5-4 Example showing distinct bands and visible squares

- If PACS test images #1 and #6 appear visually identical (with an equal number of bright and dark bands), the PACS supports VOI-LUT. Configure the PACS as `No-Burn` for this host.
- If PACS Test Images #1 and #6 appear visually different (with a different number of bright and dark bands), or if you can see saturation in the lung or abdomen of the chest region (saturation appears as a completely flat dark or white area), the PACS does not support VOI-LUT or applies it incorrectly. Configure the PACS as `Burn-on-Send` for this host.

5. Repeat sections 5.7.2.3 Sending no-burn images to the PACS and 5.7.2.4 Sending burn-on-send images to the PACS for each PACS destination host.

6. Record the results in the table below.

	Example	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7
Distinct dark bands	3							
1	0							
2	0							
3	0							
4	2							
5	3							
6	4							
7	5							
8	4							
9	4							
10	3							
11	3							
12	0							
Distinct bright bands	6							

Table 5-1 PACS image test results

In addition to the test results above, use Table 5-2 as a guideline to determine if a PACS should be configured as Burn-on-Send. This table considers only whether a PACS supports VOI-LUT

No-Burn	Burn-on-Send
GE Centricity RA1000 v1.0, v2.0, v2.1	GE Pathspeed v7.12, 8.0
GE Centricity RA600 v6.1, 7.0	GE AW v3.1, 4.0
GE Radworks v5.1	Kodak DirectView v4.3
GE Pathspeed v8.1 or later	Kodak DirectView v5.1, 5.2
McKesson HRS v3.3, 3.3.2	Kodak Directview(CEMAX ICON), v4.3
Fuji Synapse v3.0, 3.1	Merge eFilm, v2.0
Agfa IMPAX v4.5, 5.2	Stentor iSite v3.0, v3.3.1
Philips	Siemens Magic View 300
RealTime iPACS Viewer v5.0	VA Vista
-	Picker
-	Neusoft v3.0
-	Thinking Systems

Table 5-2 PACS support of VOI-LUT

5.7.3 Optional PACS tests

Perform the following tests to obtain further information for troubleshooting.

5.7.3.1 Sending all PACS test images

1. Send all nine images to PACS and follow the test instructions in Table 5-3:
   - Send images #1-5 as No-Burn
   - Send images #6-8 as Burn-on-Send
2. If the site is interested in exploring CR-Fallback as an option, configure the PACS for CR-fallback with help from the local IT team. Then send image #9 as No-Burn.

Image #	Platform	Send	Annotation notes
1	All No-Burn	None	Test No-Burn mode
2	All No-Burn	None	Identical to #1
3	All No-Burn	None	Identical to #1
4	All No-Burn	Text	Test annotations
5	All No-Burn	L	Test annotations
6	All Burn-on-Send	None	Test Burn-on-Send mode
7	All Burn-on-Send	Text	Test annotations
8	All Burn-on-Send	L	Test annotations
9	All No-Burn None	Test TEXT?	CR-Fallback

Table 5-3 Test instructions for all PACS images

5.7.3.2 Verifying DICOM header tags

1. On the PACS review workstation, open PACS test image #1 (Patient ID 2000002).
2. Access the DICOM header information through a drop-down list, a button, or by right-clicking the image and then selecting an option such as “information,” “i,” or “header.” For help, contact local IT support.
3. Verify Burn-on-Send mode by verifying that:
   a. The WC tag is 0028x1050 and the WW tag is 0028x1051
   b. The values are WC=5226\5226\5226 and WW=2654\1990\3981
4. Verify VOI-LUT tags as follows:
   a. Search the DICOM header for tag 0028x3010VOILUTSequence.
   b. Below that tag, verify that there are three additional tags:
      * 0028x3002LUTDescriptor
      * 0028x3003LUTExplanation
      * 0028x3006LUTData
   c. Verify that each VOILUTSequence has a LUTExplanation set to either Normal, Harder, or Softer.
5. Record the results in Table 5-4.
6. Open PACS test image #6 and view the DICOM header.
7. Verify No-Burn mode by ensuring that:

a. The WC tag is 0028x1050 and the WW tag is 0028x1051
b. The values are WC=8192\8192\8192 and WW=16383\12288\24575

8. Verify VOI-LUT tags as follows:
   a. Search the DICOM header for tag 0028x3010VOILUTSequence.
   b. No VOILUTSequence tag should be present. If a VOILUTSequence is present, the image was not sent correctly. Resend the image as Burn-on-Send.
9. Record the results in Table 5-4.

5.7.3.3 Verifying WC and WW values

No-Burn Mode (PACS Test Image #1)

The DICOM header of each PACS Test Image is always sent with WC/WW=5226/2654. The values displayed on the PACS may appear differently. This is acceptable according to DICOM standards. The values can show up as 8192/16384, 5226/2654, or something else. The most common and preferred implementation is to show values of 8192/16384 on the PACS.

1. Open PACS test image #1.
2. Verify that the WC/WW values are 8192/16384.

   If the values do not appear as 8192/16384, check that the VOI-LUT is enabled on the PACS. The VOI-LUT often can be enabled with a drop-down list on the image or through hanging protocols.

   Note: This does not indicate that the PACS does not support VOI-LUTs. Support for VOI-LUTs is strictly determined by the visual appearance of PACS test images #1 and #6.
3. Record the results in Table 5-4 (see 5.7.4 PACS image comparison results on page 103).

Burn-on-Send Mode (PACS Test Image #6)

1. Open PACS test image #6.
2. Verify that the WC/WW values are 8192/16384.

   If the values do not appear as 8192/16384, check that the VOI-LUT is enabled on the PACS. The VOI-LUT often can be enabled with a drop-down list on the image or through hanging protocols.
3. Record the results in Table 5-4 (see 5.7.4 PACS image comparison results on page 103).

5.7.3.4 Checking for image saturation

1. Open PACS test image #1.
2. Check that the clinical chest area appears with no saturation in the lung or abdomen region.
3. Record the results in Table 5-4.

5.7.3.5 Testing reduced dynamic range with Burn-on-Send

The Burn-on-Send configuration causes a reduced dynamic range in the image if you change the window level of the image on the PACS.

1. Open PACS test image #6.
2. Change the window level on the PACS to attempt to see the five squares in all twelve bands. Start by changing the WC value to **0** and the WW value to **500** (the appropriate values may vary among different PACS workstations).

The loss of dynamic range is most common in the top dark band. If reduced dynamic range occurs, the five squares will not be visible in the top dark band (band #1).

3. Record the results in Table 5-4.

5.7.4 PACS image comparison results

Use the values in Table 5-4 to quantitatively compare images. For example, to determine if a PACS supports GE VOI-LUTs, compare PACS test images #1 and #6. If the number of distinct bands and visible squares are equal, then the PACS correctly supports VOI-LUTs.

Tests	Results
DICOM header on PACS (image #1 No-Burn)	WC = _____ WW = _____ VOI-LUT (Yes/No)
DICOM header on PACS (image #6 Burn-on-Send)	WC = _____ WW = _____ VOI-LUT (Yes/No)
Values displayed on PACS viewer (image #1)	WC = _____ WW = _____
Values displayed on PACS viewer (image #6)	WC = _____ WW = _____
Saturation visible in lung or abdomen region	
Able to see all five squares in top band of image #6	
Able to see all five squares in top band of image #1	
Images #1, 4, 5 appear visually identical	
Images #6, 7, 8 appear visually identical	
PACS able to select Normal/Harder/Softer	
DICOM header on PACS (image #9 CR-Fallback).	VOI-LUT not present; correct WW/WC

Table 5-4 PACS image comparison results

Chapter 6 Mechanical adjustment procedures

HAZARDS EXIST

THE POTENTIAL FOR INJURY OR DEATH FROM ELECTRICAL AND MECHANICAL HAZARDS IS HIGH. CAREFULLY READ AND FOLLOW INSTRUCTIONS. ALWAYS LOTO THE SYSTEM BEFORE ATTEMPTING SERVICE OF ANY KIND, AS DESCRIBED IN Chapter 1 Safety / Before You Begin**.**

Section 6.1 Column related assemblies

6.1.1 Column balance procedure

6.1.1.1 Personnel requirements

Required persons: 1

Timing (min): 20

6.1.1.2 Preliminary requirements

6.1.1.2.1 Tools and test equipment

- Standard tool kit

6.1.1.2.2 Consumables

- Loctite 242 (GE part# 46-170686P2) or equivalent

6.1.1.2.3 Replacement parts

- None

6.1.1.2.4 Safety

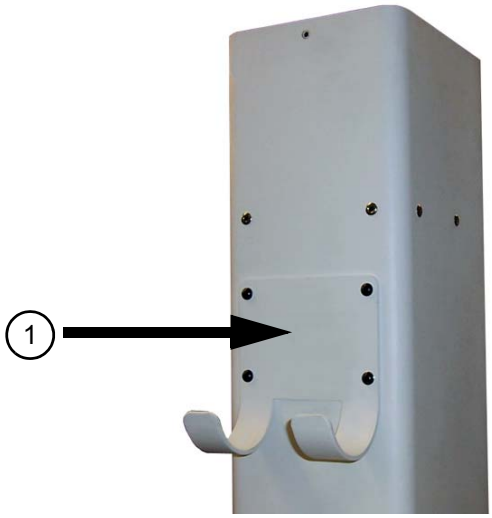
- None

6.1.1.2.5 Required conditions

- None

6.1.1.3 Procedure

1. Remove the apron hanger bracket from the vertical column. See Figure 6-1.

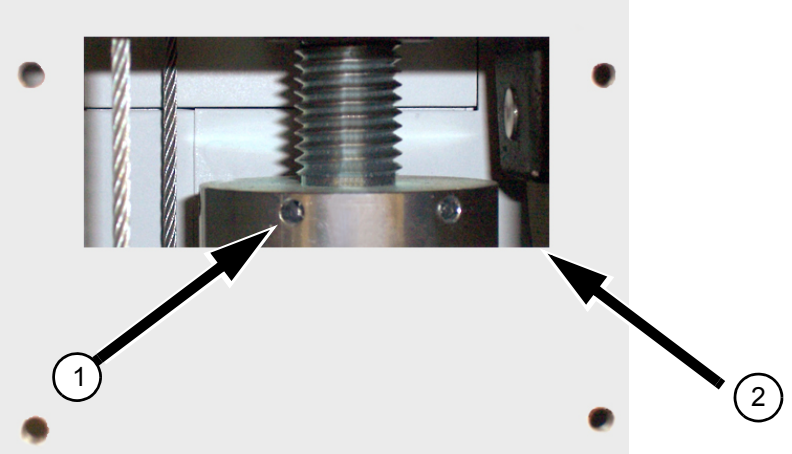


Item	Description
1	Apron hanger bracket

Figure 6-1 Apron hanger bracket

2. You now can see the top of the compressed spring assembly (see Figure 6-2). There is up to 1.5 inches of adjustment before the tool insertion becomes un-usable.

Note: The column comes pre-adjusted such that the fine adjustment range falls within the physical adjustment opening in the column (see Figure 6-2, Item 2). Do not attempt to adjust the spring tension if the tool does not engage in the adjustment holes easily.



Item	Description
1	Counterbalance adjustment holes
2	Physical adjustment opening in the column

Figure 6-2 Vertical counterbalance adjustment

3. Raise the tube arm to approximately 2.5 cm (1 in) from the top of the column. This reduces spring tension, allowing easier adjustment.
4. Using a 4 mm hex key inserted into the adjustment holes (see Figure 6-2), you can adjust the spring tension for up to 5 lbs of balance force.
5. Rotating the assembly clockwise reduces the tension on the spring resulting in less buoyancy of the arm.
6. Rotating the assembly counter-clockwise increases the tension on the spring resulting in more buoyancy of the arm.
7. Adjust the spring tension such that 80% of the main travel is stable. 10% at the lowest tube position and 10% of the highest tube position should have minimal to no movement when the brakes are engaged.
8. Apply thread locker (i.e. Loctite 242 [blue]) to the apron hanger bracket screws. Install the bracket and tighten the screws.

6.1.2 Tube latch to arm pin adjustment procedure

6.1.2.1 Personnel requirements

Required persons: 1

Timing (min): 20

6.1.2.2 Preliminary requirements

6.1.2.2.1 Tools and test equipment

- Standard tool kit

6.1.2.2.2 Consumables

- None

6.1.2.2.3 Replacement parts

- None

6.1.2.2.4 Safety

- None

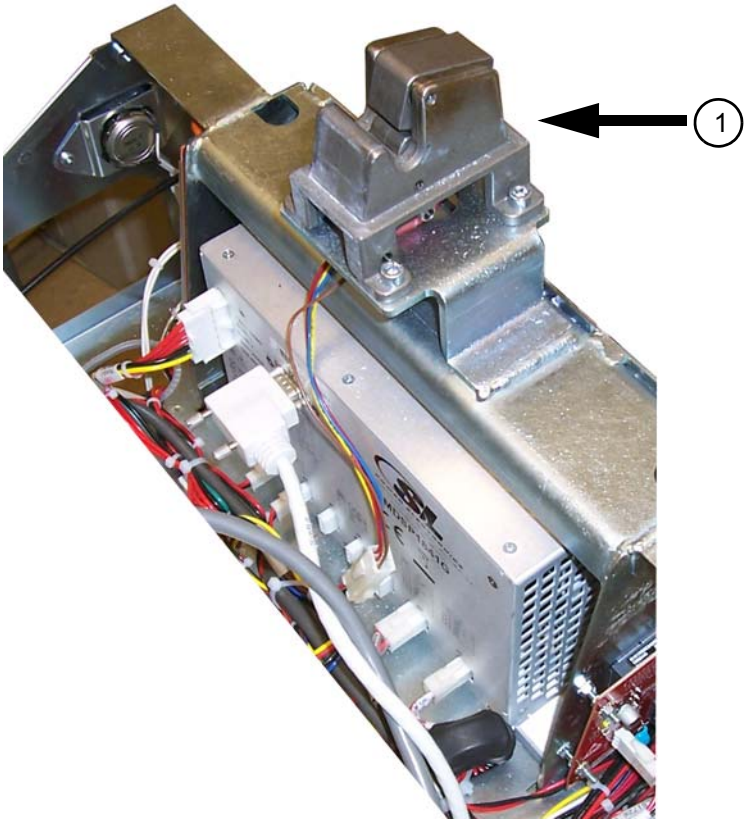
6.1.2.2.5 Required conditions

- None

6.1.2.3 Procedure

Note: The tube latch assembly mounted to the main body of the mobile unit (called the Thorax assembly) has minimal to no adjustment capability. Therefore, the adjustments must be performed relative to the tube latch pin arm mounting assembly. There is up to 13 mm of adjustment capability for smooth and reliable engagement of the tube latch assembly.

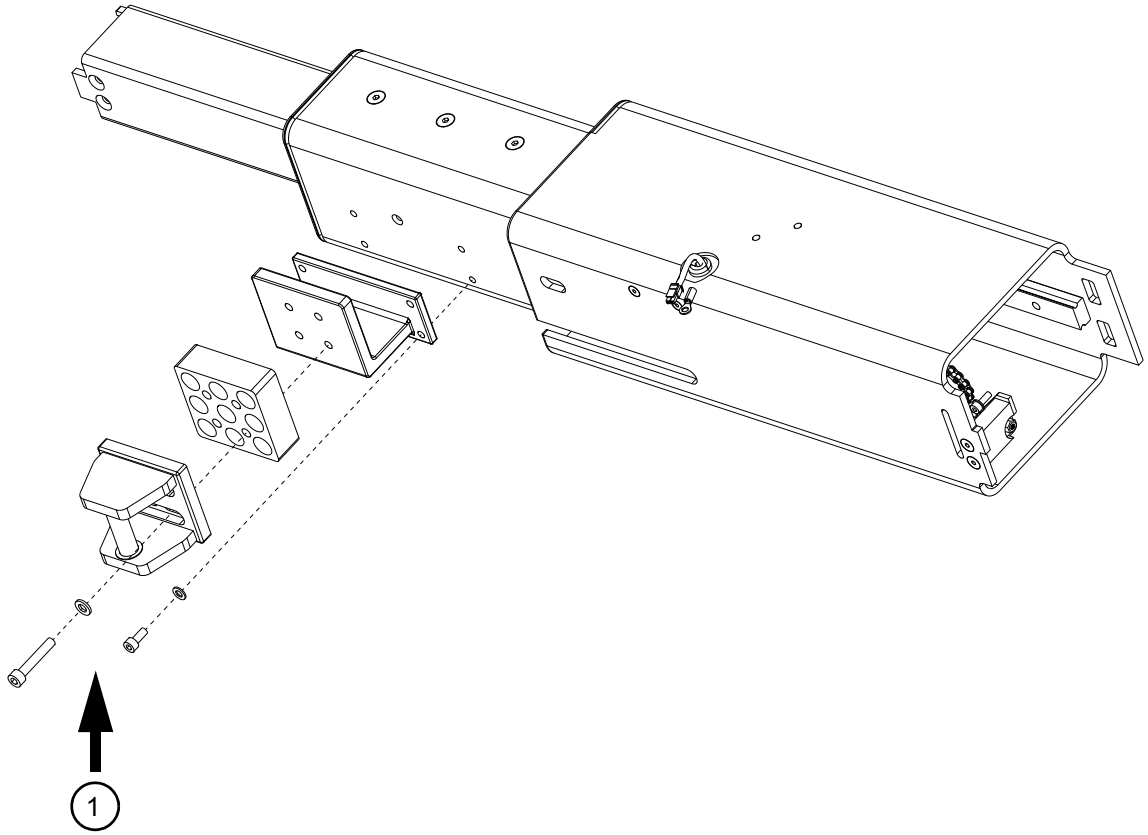
1. Ensure the tube latch assembly is properly secured to the Thorax. See Figure 6-3.



Item	Description
1	Tube latch assembly

Figure 6-3 Tube latch assembly on Thorax

2. Adjust the screw tension of the tube latch pin assembly on the horizontal arm (see Figure 6-4) such that it is snug but can be moved forward/backward with slight effort.
3. Make sure the arm is fully retracted/compressed.



Item	Description
1	Tube latch pin assembly

Figure 6-4 Tube latch pin assembly

4. Lower the horizontal arm so that it engages with the Thorax tube latch assembly. Manually slide the tube latch pin assembly to facilitate the engagement.
5. Manually release the Thorax side of the tube latch such that the horizontal arm side of the pin assembly is not disturbed.
6. Carefully torque fasteners of the tube latch pin assembly to 8.1 N-m (6 lb-ft) - no thread locker is used. See Figure 6-4.
7. Raise and lower the horizontal arm such that the arm latching feature can be engaged and disengaged several times to ensure smooth and reliable functionality.

6.1.3 Column rotational detent procedure

6.1.3.1 Personnel requirements

Required persons: 1

Timing (min): 20

6.1.3.2 Preliminary requirements

6.1.3.2.1 Tools and test equipment

- Standard tool kit

6.1.3.2.2 Consumables

- None

6.1.3.2.3 Replacement parts

- None

6.1.3.2.4 Safety

- None

6.1.3.2.5 Required conditions

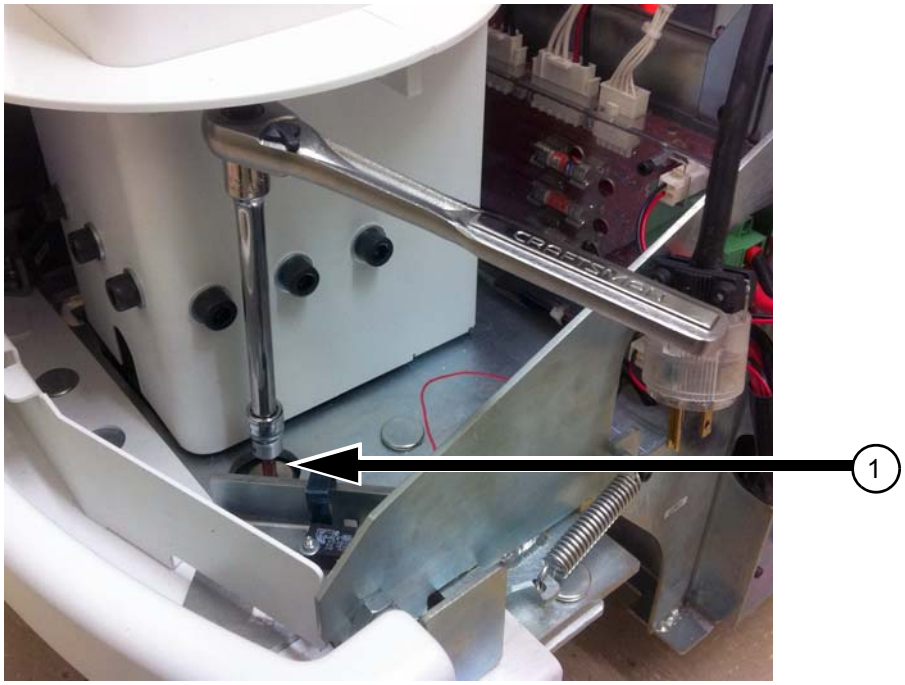
- None

6.1.3.3 Procedure

1. Ensure the tube latch to arm pin adjustment procedure has been completed (see 6.1.2 Tube latch to arm pin adjustment procedure on page 108).
2. Disengage the tube latch and raised the tube slightly above the tube latch.
3. Using the collimator left/right lock switch buttons, rotate the column such that you feel the column rotation detent setting.
4. Release the collimator lock switches when the column rotational lock detent is felt.
5. Lower the tube to engage the tube latch assembly.
   If the alignment is not correct, proceed with the following steps.

Column rotation detent adjustment

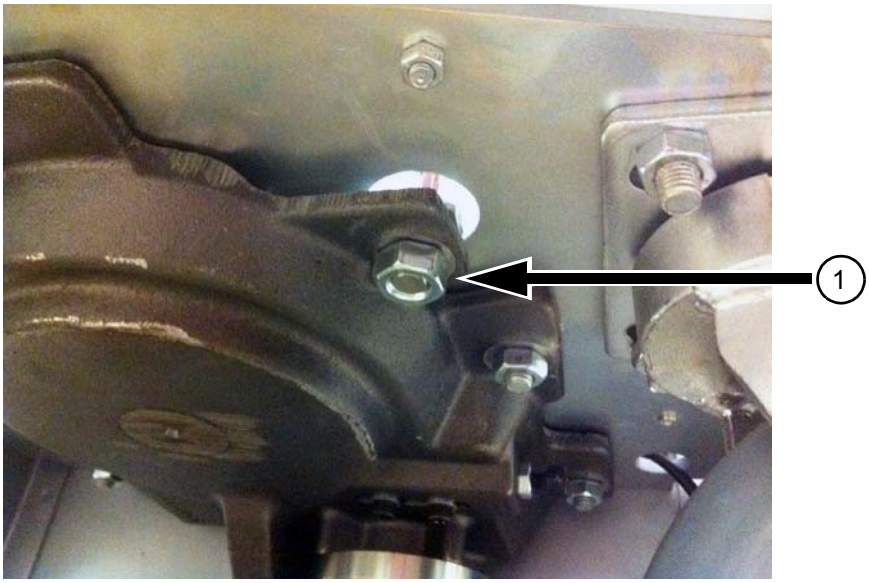
1. Remove the left side cover and left front cover. See 8.1.3 Front cover removal on page 152.
2. Locate the column detent eccentric adustment (Item 1) as shown in Figure 6-5. A 6mm Allen wrench or adapter (for ratchet) is required for the adjustment.



Item	Description
1	Column detent eccentric adjustment

Figure 6-5 Column detent eccentric adjustment

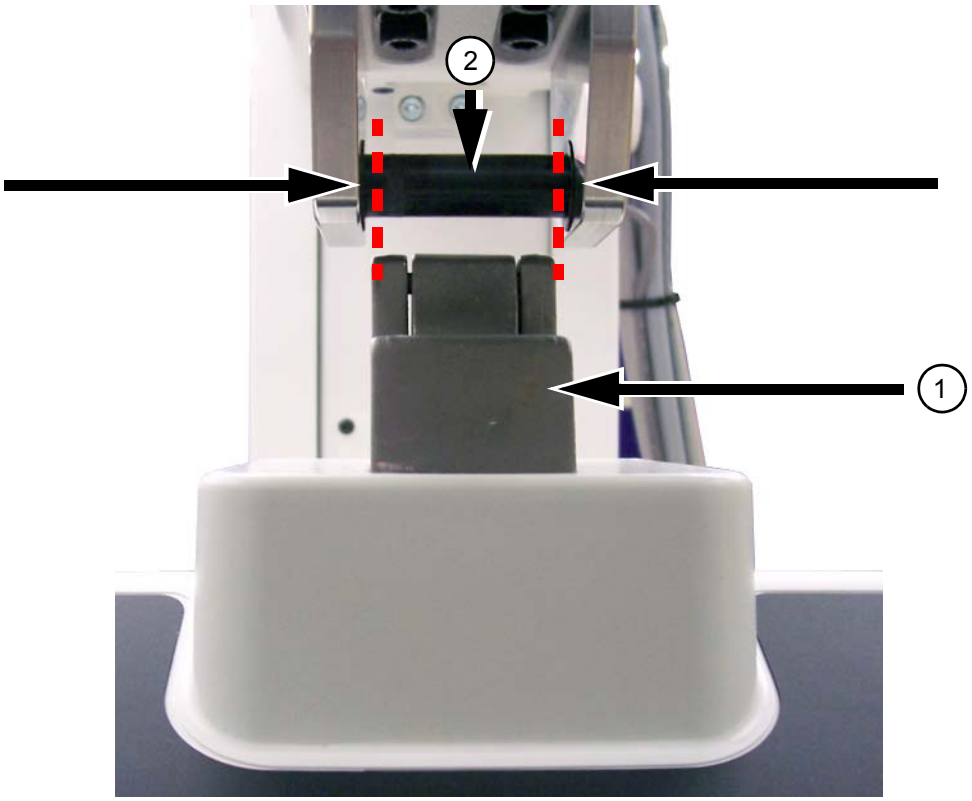
3. Locate the column detent lock nut (Figure 6-6, Item 1) at the bottom of the column (under-side of the chassis). While holding the eccentric adjustment from the top, loosen the detent lock nut with a 3/4" wrench or socket.



Item	Description
1	Column detent lock nut

Figure 6-6 Column detent lock nut

4. The detent is adjusted through the use of an eccentric, using a 6 mm Allen wrench. Rotate the eccentric to adjust the left-to-right positioning of the tube latch pin (located on bottom of the horizontal arm) such that it squarely aligns with the tube latch assembly (located on top of the Thorax). See Figure 6-7.



Item	Description
1	Tube latch assembly
2	Tube latch pin

Figure 6-7 Column detent latch alignment

5. While holding the eccentric adjustment in position to prevent movement, torque the 3/4" column detent lock nut to 18N-m (13.3 lb-ft).
6. Using the collimator left/right lock switches to disengage the locks, rotate the column left and right such that it stops in the detent and then verify the tube latch mechanism engages smoothly and reliably from both clockwise and counterclockwise rotational directions. Re-adjust as necessary.
7. Install the front and side covers.

Chapter 7 Regulatory testing

When instructed to do so during installation, planned maintenance, or repair procedures, complete the tests in this chapter to meet U.S. federal regulatory compliance requirements and to ensure that X-rays are generated properly.

Section 7.1 U.S. federally required tests

Note: **Important!** The regulatory tests described in this section are required by the United States Health and Human Services (HHS) Department for U.S. installations. US-only or as required by local regulations.

7.1.1 Required test equipment

Gather the test equipment, tools, and materials listed below. Record the serial number and calibration due date, if applicable. Also record the manufacturer if not specified below.

- HHS test kit (GE 46-303879G1, 46-315694G1)
- Oscilloscope
- Radiation meter with integrate mode
- Probe test stand
- Light meter with 5% accuracy rating
- Digital multimeter
- Light to X-ray field test pattern (GE 46-303843P1 or equivalent)
- Ground tester (Hioki 3157 or equivalent)
- Leakage tester (Dale 601/601E or equivalent)

7.1.2 Preparing for testing

For all tests, verify that the DAP meter is removed from the collimator rails unless otherwise specified.

Before beginning testing, perform the required calibrations (see Chapter 5 Calibration).

7.1.3 Collimator testing

Perform these tests to verify that:

- The collimator lamp illuminates properly
- The light field and X-ray field are aligned
- The field size matches the expected size per the settings on the collimator

7.1.3.1 Testing light intensity

Use this procedure to verify that the collimator high-intensity field lamp illuminates at a distance of 100 cm (39.37 in) from the focal spot at no less than the light intensity specification in Table 7-1.

Site location	Light intensity
Within the U.S.	160 lux (14.9 ft-c)

Table 7-1 Light intensity specification

1. Verify that the light meter has an accuracy of 5% or better.
2. Remove the collimator covers.
3. Adjust the CLS (collimator lamp supply) potentiometer so that the voltage at the collimator lamp is 20.0 - 22.0 V.

Note: Ignore voltage polarity. The lead positions dictate polarity.

4. Place the light meter on a horizontal surface 40 inches from the X-ray tube focal spot. Direct the sensor toward the collimator light source.
5. Turn on the collimator lamp.

Note: **Important!** To ensure that the lamp reaches full brightness, wait while the lamp illuminates and then automatically shuts off after 30 seconds. Then turn on the lamp again and proceed to the next step.

6. Use the dials on the front of the collimator to adjust the field size to 10 x 10 inches.
7. Turn off the collimator lamp.
8. Turn off the room lights and use the light meter to measure the ambient light level. Record the ambient light level here:

   Ambient light level: _____
9. Turn on the collimator lamp.
10. Position the light meter in the center of each quadrant and record the intensity of the light field here:

    Quadrant 1: _____

    Quadrant 2: _____

    Quadrant 3: _____

    Quadrant 4: _____
11. Turn off the collimator lamp.
12. Calculate the average illumination by summing the light levels of the 4 quadrants and dividing by 4, then subtracting the ambient light level. Record the average illumination here:

    Average illumination: _____

13. Verify that the average illumination is greater than the ambient brightness by the specification listed in Table 7-1.

7.1.3.2 Testing light field to X-ray field alignment

Use this test to verify that the light field and X-ray field are aligned laterally and longitudinally. Total misalignment may not exceed the specification that pertains to the site, given below.

Table 7-2 Light field to X-ray field alignment specification by site

Site location	Total misalignment
Within the U.S.	Not to exceed 1.8% of SID

Be sure to follow the instructions for Optima XR200amx or Optima XR220amx, as appropriate. For example, the Optima XR200amx uses a cassette as a receptor, whereas the Optima XR220amx uses a digital detector.

This procedure requires a light to X-ray test pattern, GE p/n 46-303843P1.

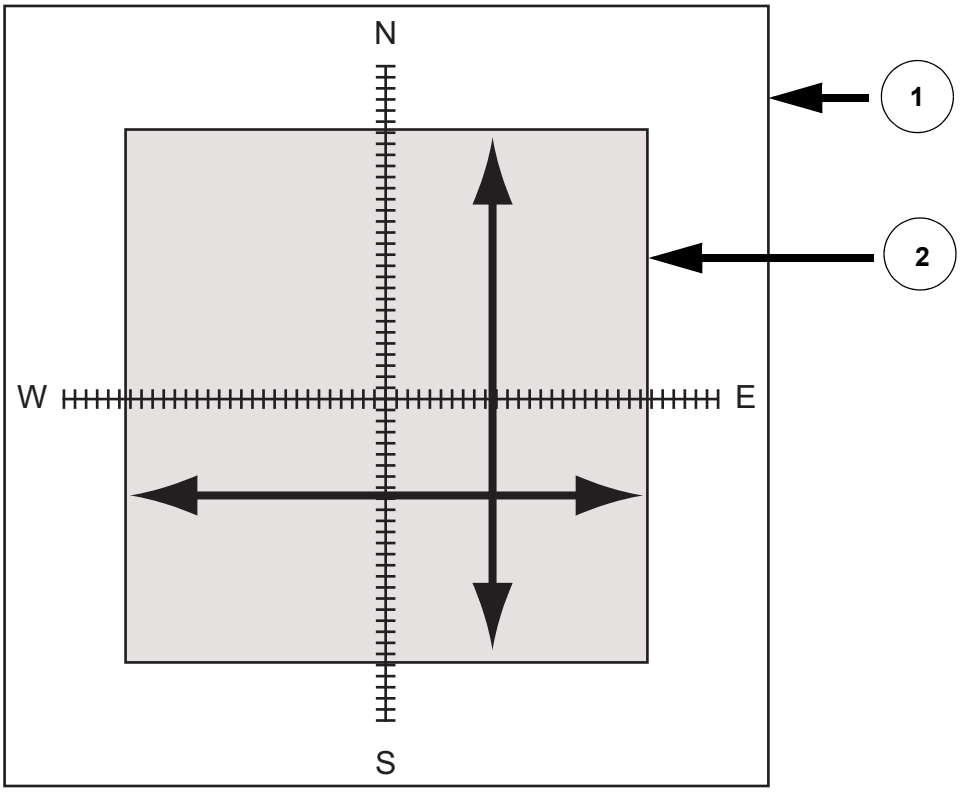
7.1.3.2.1 Preliminary test - light field accuracy

Note: If this test fails, then the Light to X-ray field alignment test on page 118 will fail.

1. Place the X-ray receptor on a flat, horizontal surface such as a table or floor 40 inches from the source.
2. Place the light to X-ray field test pattern on the receptor and center it squarely.
3. Align the X-ray tube to the receptor.
4. Set the source-to-image distance (SID) to 40 inches.
5. Use the collimator dials to adjust the light field settings to 10 X 10 inches on **the collimator scales**.
6. Turn on the field light and squarely center the crosshair on the test pattern.
7. Minimize the room lights.
8. See Figure 7-1. Measure the light field projection edges on the test pattern marks to the 10 X 10 inches test pattern scale for each North, South, East, and West vector. (This is the error measurement.)
   - If the light field is outside the test pattern scale, record it as a positive (+) value.
   - If the light field is inside the test pattern scale, record it as a negative (-) value.

   Enter the measurements here:

   Error measurement: N _____ S_____ E_____ W_____



Item	Description
1	Light field to X-ray field test pattern
2	Light field or X-ray field

Figure 7-1 Light to X-ray field test

9. Calculate the absolute error value for N+S and E+W and record it here:
   ABS(N+S) error: _____
   ABS (E+W) error: _____
10. Determine the percentage of misalignment and record it here:
    ABS(N+S) error / SID * 100 = _____
    ABS(E+W) error / SID * 100 = _____
    Pass criteria is ≤ 1.8% SID

7.1.3.2.2 Light to X-ray field alignment test

1. Prepare for an exposure.
2. Align the X-ray tube to the receptor for a SID = 40 inches.
3. Place the test pattern on the receptor and center it squarely.
4. Use the collimator dials to adjust the light field settings to 10 X 10 inches **on the test pattern**.
5. Minimize the room lights.
6. Select 50 kVp and 1 mAs (small spot).
7. Make an exposure.
8. Continue with the appropriate procedure below:
   - For Optima XR200amx, see 7.1.3.2.3 Light field to X-ray field alignment (Optima

XR200amx) on page 119.

- For Optima XR220amx or Optima XR200amx with digital upgrade, see 7.1.3.2.4 Light field to X-ray field alignment (Optima XR220amx or Optima XR200amx with digital upgrade) on page 119.

7.1.3.2.3 Light field to X-ray field alignment (Optima XR200amx)

1. Open the collimator blades to 12 X 12 inches.
   Be careful not to bump the receptor or test pattern.
2. Make another exposure on the same receptor.
3. Develop the film in a dark room.
4. Use a light box to locate the edges of the 10 X 10 inch field, and make a pencil mark on the North, South, East, and West edges of the 10 X 10 inch X-ray field.
5. Measure from the 10 X 10 inch test pattern mark (light field) to the pencil mark of the 10 X 10 inch X-ray field for each North, South, East, and West vector. This is the error measurement.
   - If the light field is outside the test pattern scale, record it as a positive (+) value.
   - If the light field is inside the test pattern scale, record it as a negative (-) value.

   Enter the measurements in the X-ray field row of Table 7-3.

Value	N	S	E	W
Light field	5	5	5	5
X-ray field				
Error				

Table 7-3 Optima XR200amx light field to X-ray field alignment

6. Calculate the absolute error value for N+S and E+W and record it here:
   ABS(N+S) error: _____
   ABS (E+W) error: _____
7. Determine the percentage of misalignment and record it here:
   ABS(N +S) error / SID * 100 = _____
   ABS(E +W) error / SID * 100 = _____
8. Verify that the percentage of misalignment is within the specification in Table 7-2.

7.1.3.2.4 Light field to X-ray field alignment (Optima XR220amx or Optima XR200amx with digital upgrade)

1. Select the RAW image, select Annotation, select Measurement Tools, then select line cursors.
2. Using the Line Measurement Tools, measure the text pattern scale number seen for each North, South, East, and West edge of the image. This is the X-ray field dimension (for example, 4.7).

Enter the measurements in the X-ray field row of Table 7-4.

Value	N	S	E	W
Light field	5	5	5	5
X-ray field				
Error				

Table 7-4 Optima XR220amx light field to X-ray field alignment

3. Determine the error (difference) between the light field and X-ray field values for the N, S, E, and W vector.
   - If the X-ray field value is greater than 5, record the error as a positive (+) value.
   - If the X-ray field value is less than 5, record the error as a positive (+) value.
4. Calculate the absolute error value for N+S and E+W and record it here:
   ABS(N+S) error: _____
   ABS (E+W) error: _____
5. Determine the percentage of misalignment and record it here:
   ABS(N +S) error / SID * 100 = _____
   ABS(E +W) error / SID * 100 = _____
6. Verify that the percentage of misalignment is within the specification in Table 7-2.

7.1.3.3 Testing field size indicator accuracy (Optima XR200amx)

For Optima XR220amx or Optima XR200amx with digital upgrade, see 7.1.3.4 Testing field size indicator accuracy (Optima XR220amx or Optima XR200amx with digital upgrade) on page 121.

Use this test to ensure that the difference between the indicated field size and the actual field size is not greater than the specification that pertains to the site, given below.

Site location	Total difference
Within the U.S.	Not to exceed 1.8% SID in either direction

Table 7-5 Field size indicator specification by site

1. Prepare for an exposure.
2. Align the X-ray tube to the receptor.
3. Set the SID to 100 cm.
4. Set the X-ray angle to 0 degrees.
5. Set the field size to 25 x 25 cm.
6. Select 50 kVp and 1 mAs.
7. Take an exposure.
8. Develop the film in a dark room.
9. Use a light box to locate the edge of the first X-ray field, and place a pencil mark on the North, South, East, and West edges of the X-ray field.
10. Measure from the pencil mark to the 25 x 25 cm exposure edges.
11. Record the measured value of the North-South distance (d1) here:
    d1: _____
12. Record the measured value of the East-West distance (d2) here:

d2: _____

13. Calculate the indicator to actual size error.

$$\frac{25\text{ cm} - \text{actual size d1}}{100\text{ cm}} \times 100 \qquad \frac{25\text{ cm} - \text{actual size d2}}{100\text{ cm}} \times 100$$

14. Record the error values here:

    (d1) = height of image % error _____

    (d2) = width of image % error _____

15. Verify that the difference between indicated field size and actual field size does not exceed the specification in Table 7-5.

7.1.3.4 Testing field size indicator accuracy (Optima XR220amx or Optima XR200amx with digital upgrade)

For Optima XR200amx, see 7.1.3.3 Testing field size indicator accuracy (Optima XR200amx) on page 120.

Use this test to ensure that the difference between the indicated field size and the actual field size is not greater than the specification that pertains to the site, given below.

Table 7-6 Field size indicator specification by site

Site location	Total difference
Within the U.S.	Not to exceed 1.8% SID in either direction

To determine image size and centering, exposures are to be completed in Application mode. All measurements are to use the RAW image.

1. Prepare for an exposure.
2. Align the X-ray tube to the receptor.
3. Set the SID to 100 cm.
4. Set the X-ray angle to 0 degrees.
5. Set the field size to 25 x 25 cm.
6. Select 50 kVp and 1 mAs.
7. Take an exposure.
8. Select the Measurement Tools icon, and select Line.
9. Using the Line Measurement tool, measure the size of the X-ray image at the detector plane.

    Line values are displayed in the bottom right corner of the screen.
10. Measure the distance between the front blade and rear blade of the image. Record that value as d1, here:

    d1 _____
11. Measure the distance between the left blade and right blade of the image. Record that value as d2, here:

    d2 _____
12. Calculate the indicator to actual size error, using d1 and d2 from above.

$$\frac{25\text{ cm} - \text{actual size d1}}{100\text{ cm}} \times 100 \qquad \frac{25\text{ cm} - \text{actual size d2}}{100\text{ cm}} \times 100$$

13. Record the error values here:

    (d1) = height of image % error _____

(d2) = width of image % error _____

14. Verify that the difference between indicated field size and actual field size does not exceed the specification in Table 7-6.

7.1.4 Generator tests

7.1.4.1 Operator warning message

Verify that the following warning message is displayed on the control panel (ensure the warning label of the applicable language is legible as required by local regulations):

"Warning: This X-ray unit may be dangerous to patient and operator unless safe exposure factors, operating instructions and maintenance schedules are observed. To be used by authorized personnel only."

7.1.4.2 Testing kVp accuracy

Perform the kVp accuracy test to determine whether actual X-ray energy generated by the system at a particular voltage matches the expected energy (within a specified tolerance).

kVp accuracy is measured using a non-invasive meter

7.1.4.2.1 Piranha test meter setup

Setting up the Piranha and Palm OS for wireless connectivity

1. Power on the Piranha using the power switch.
2. Place the Piranha under the tube or mount it on a stand as needed.
   Position the Piranha in such a way that the area is orientated perpendicular to the anode/cathode axis.
3. Collimate the X-ray field slightly larger than the Piranha active sensor.

QABrowser for kVp Accuracy Test

Note: **DO NOT SELECT THE "AMX-4" MODE (UNDER SETTINGS/WAVEFORM) ON THE METER. THE "AMX-4" MODE IS NOT VALID FOR USE WITH THIS PRODUCT.**

1. Turn on the Palm OS.
2. Launch the QABrowser by tapping on the *QABrowser* icon.
   * Please note that **All** needs to be selected at the top of the screen for the **QABrowser** icon to be visible.
3. The handheld searches for available Bluetooth devices and shows them to you.
4. Select the **Piranha meter** and Press **Ok**.
   * Please note that the Piranha meter might be selected automatically thus proceeding to the next step.
5. From the **Select Type of Measurement** Menu select **Radiography** and press **Select**.
6. From the **Select Parameter** Menu select **Tube Voltage** and press **Select**.
7. Tap **Appl** to open application list.
8. From **Select Application** Menu choose **Accuracy** and then tap the **Back** button to bring you back to the kVp measurement screen.

7.1.4.2.2 Procedure

1. Turn on system power and boot up the system.
2. Position the tube above the kVp meter at a SID of 100 cm (39.4 in).
3. Collimate the beam to slightly larger than the kVp meter active sensor.
4. Select the kV and mAs as defined in Table 7-7 (for 15 kW generator) or Table 7-8 (for 30 kW generator).

Table 7-7 kV and mAs settings for kVp accuracy - 15 kW generator

Sample	Selected kV	Selected mAs	Exposure Time (See Note)
1	50	2.5	<40mS
2	80	2.5	<40mS
3	125	1.6	<40mS
4	50	25	>40mS
5	80	20	>40mS
6	125	12.5	>40mS
Note: Exposure Time reference is for generator specifications (not selectable).			

Table 7-8 kV and mAs settings for kVp accuracy - 30 kW generator

Sample	Selected kV	Selected mAs	Exposure Time (See Note)
1	50	2.5	<40mS
2	80	2.5	<40mS
3	125	1.6	<40mS
4	50	25	>40mS
5	80	32	>40mS
6	125	25	>40mS
Note: Exposure Time reference is for generator specifications (not selectable).			

5. Make an exposure and measure the kVp value. Record the values in Table 7-9 (for 15 kW generator) or Table 7-10 (for 30 kW generator).

Table 7-9 kVp values for kVp accuracy - 15 kW generator

Sample	Measured kVp	Acceptance Criteria
1		+/- 4 kVp and +/- 2% of selected kVp
2		+/- 4 kVp and +/- 2% of selected kVp
3		+/- 4 kVp and +/- 2% of selected kVp
4		+/- 4 kVp of selected kVp
5		+/- 4 kVp of selected kVp
6		+/- 4 kVp of selected kVp

Table 7-10 kVp values for kVp accuracy - 30 kW generator

Sample	Measured kVp	Acceptance Criteria
1		+/- 4 kVp and +/- 2% of selected kVp
2		+/- 4 kVp and +/- 2% of selected kVp
3		+/- 4 kVp and +/- 2% of selected kVp
4		+/- 4 kVp of selected kVp
5		+/- 4 kVp of selected kVp
6		+/- 4 kVp of selected kVp

6. Verify that the kVp accuracy passes the regulatory limits for each test exposure.

7.1.4.3 Testing mAs accuracy

7.1.4.3.1 Overview

mAs accuracy is measured using a non-invasive kVp meter and oscilloscope connected to the mA test point of the generator. Considering a threshold of 75% of the requested kV, the mAs is the integral of the mA during the exposure time:

The exposure time (pulse width) is the time between when the kV waveform rises above the threshold and when the kV falls back below the threshold.

For short exposure times (< 15 mSec), it is necessary to accurately measure and calculate the mAs by integrating the mA and time in defined intervals. (Three are used for this example.)

The integrated values are the sum of the weighted means of the measured time intervals for the full exposure time.

Mt1+ Mt2 + Mt3 = MT

Where

M = mean of the measured mA

t1, t2, t3 = time interval of the measured mean of mA (Mt1, Mt2, Mt3)

T = total exposure time @ 75% of kVp rise and fall value.

MT * T = mAs

This is simplified by the use of an oscilliscope that supports signal integration. The TDS 3000 family of scopes provides this function using vertical cursors and gating cursors selections. So a single measurement can be made for the full exposure defined as T above with a highly accurate result.

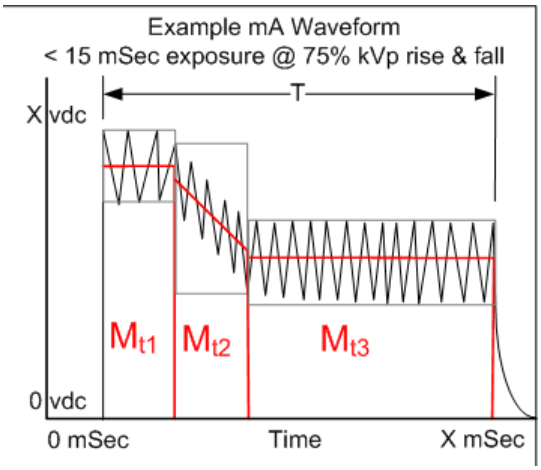


Figure 7-2 mA waveform, example 1

For exposures > 15 mSec the waveform stabilizes and the effects of Mt1 and Mt2 become negligible.

Using the cursor gating function find the mean of the entire waveform.

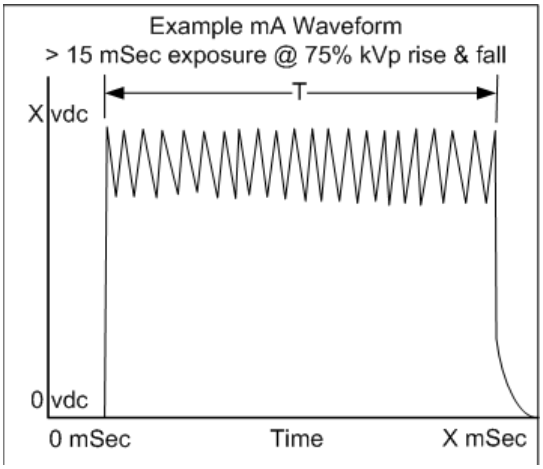


Figure 7-3 mA waveform, example 2

Note: Because of the nature of the design of the high frequency generator, the use of a kV meter to determine kVp rise time is not necessary. The rise/fall of the kVp waveform has negligible impact upon the mAs measurement.

7.1.4.3.2 Procedure

1. Connect a CH 1 scope probe to TP5 (signal scale is 100mA = 1V) of the generator and chassis ground. See Figure 7-4.

   Note: TP4 is the mA Anode Negative signal and can be used in place of TP5.

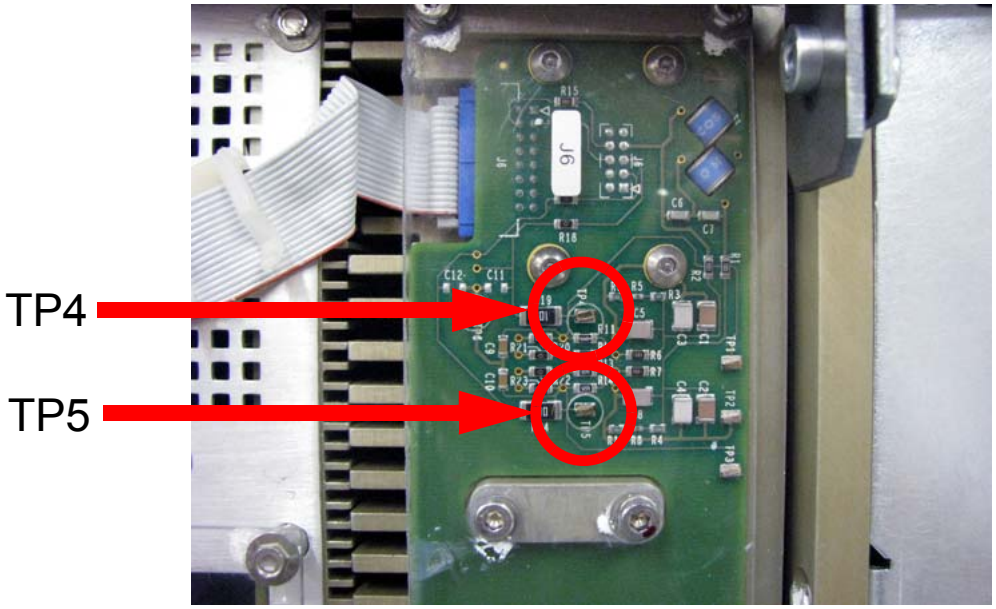


Figure 7-4 Generator TP4 & TP5 mAs test points

2. Select the kV and mAs as defined in Table 7-11 (for 15 kW generator) or Table 7-12 (for 30 kW generator).

Table 7-11 kV and mAs settings for mA accuracy - 15 kW generator

Sample	Selected kV	Selected mAs	Exposure Time (See Note)
1	50	2	<15mS
2	125	1.25	<15mS
3	50	25	>15mS
4	125	12.5	>15mS
Note: Exposure Time reference is for generator specifications (not selectable).			

Table 7-12 kV and mAs settings for mA accuracy - 30 kW generator

Sample	Selected kV	Selected mAs	Exposure Time (See Note)
1	50	2	<15mS
2	125	1.25	<15mS
3	50	25	>15mS
4	125	25	>15mS
Note: Exposure Time reference is for generator specifications (not selectable).			

3. Adjust scope settings to display a single waveform.
4. Using the vertical cursor measurement functions, position the cursors on the mA waveform at 75% of the rise/fall for the entire exposure.
5. Using the undisturbed vertical cursor measurement functions, record the mean of the mA waveform for the entire exposure. This requires using the integration function of the oscilliscope. Each scope can vary as to how this is performed.

   For the TDS 3000 Series scopes, the following applies.

a. Press the **MEASURE** button. Press the **GATING** button (ignore on/off state).
b. Press the **BETWEEN THE V BAR CURSORS** button.
c. Press **SELECT MEASUREMENT FOR CH 1** button.
d. Change selections as need and select **MEAN**.

6. Record the CH 1 Mean value in Table 7-13 (for 15 kW generator) or Table 7-14 (for 30 kW generator).

Table 7-13 Ch1 Mean value - 15 kW generator

Sample	Ch1 Mean value	Measured Time	Acceptance Criteria
1			+/- 20% or 0.1mAs, whichever is greater
2			+/- 20% or 0.1mAs, whichever is greater
3			+/- 5% or 0.1mAs, whichever is greater
4			+/- 5% or 0.1mAs, whichever is greater

Table 7-14 Ch1 Mean value - 30 kW generator

Sample	Ch1 Mean value	Measured Time	Acceptance Criteria
1			+/- 20% or 0.1mAs, whichever is greater
2			+/- 20% or 0.1mAs, whichever is greater
3			+/- 5% or 0.1mAs, whichever is greater
4			+/- 5% or 0.1mAs, whichever is greater

7. Verify that mAs accuracy passes the regulatory limits for each test exposure.

7.1.4.4 Testing reproducibility and linearity of exposure

7.1.4.4.1 Overview

Reproducibility: For any specific combination of selected technique factors, the estimated coefficient of variation (C.V.) of radiation exposures shall be no greater than 0.05.

Linearity: The quotients of the average measured dose divided by the selected technique values at 2 consecutive settings shall not exceed 0.10 times their sum result for HHS.

7.1.4.4.2 Piranha test meter setup

Setting up the Piranha and Palm OS for wireless connectivity

1. Power on the Piranha using the power switch.
2. Place the Piranha under the tube or mount it on a stand as needed.
   Position the Piranha in such a way that the area is orientated perpendicular to the anode/cathode axis.
3. Collimate the X-ray field slightly larger than the Piranha active sensor.

QABrowser for Reproducibility Test

Note: **DO NOT SELECT THE "AMX-4" MODE (UNDER SETTINGS/WAVEFORM) ON THE METER. THE "AMX-4" MODE IS NOT VALID FOR USE WITH THIS PRODUCT.**

1. Turn on the Palm OS.
2. Launch the QABrowser by tapping on the *QABrowser* icon.
   * Please note that **All** needs to be selected at the top of the screen for the **QABrowser** icon to be visible.
3. The handheld searches for available Bluetooth devices and shows them to you.
4. Select the **Piranha meter** and Press **Ok**.
   * Please note that the Piranha meter might be selected automatically thus proceeding to the next step.
5. From the **Select Type of Measurement** Menu select **Radiography** and press **Select**.
6. From the **Select Parameter** Menu select **Dose** and press **Select**. This brings you to the mGy (dose) measurement screen.
7. Tap **Appl** to open application list.
8. From **Select Application** Menu choose **Reproducibility** and then tap the **Back** button twice. This brings you back to the mGy (dose) measurement screen.

Note: When the exposure is less than 5ms:

The default time on the Piranha is set to 5ms, which records a low signal continuously since the exposure time is shorter than 5ms.

1. Tap the **i** symbol.
2. Under **Conditions** Menu select **Internal Detector.**
3. Under **Delay** drop down menu select **Off.**

7.1.4.4.3 Procedure

Data collections for each sample set defined in the tables below consist of 10 exposures each. **Each sample of 10 exposures must be completed within 1 hour of start**. There are a total of 60 exposures required to complete this section.

1. Position the dose probe 30 cm above the floor to limit scatter effects.
2. Position the tube above the probe at a SID of 100 cm.
3. Collimate the beam to slightly larger than the dose probe active sensor.
4. Select the kV and mAs starting with Sample A in Table 7-15.

Table 7-15 kV and mAs values for reproducibility tests - 15kW and 30kW generator

	Selected kV	Selected mAs
Sample A	80	32
	SID = 100 cm	
Sample B	80	40
	SID = 100 cm	

5. Measure the exposure in uGy for each of the 10 exposures. **Each sample of 10 exposures must be completed within 1 hour of start**.

   After each exposure, recycle the technique (switch to other values and then return them to the original values). Also vary the time between exposures to capture any filament heating variations.

6. Measure and record the values in Table 7-16.

Table 7-16 Measured uGy values

Sample	Measured uGy for each exposure									
	1	2	3	4	5	6	7	8	9	10
A										
B										

7. Repeat this process of 10 exposures with Sample B, using the correct techniques as given in Table 7-15.
8. Verify that the reproducibility (Coefficient of Variation) for samples A and B is < 0.045 as calculated.

   Calculation:

   [CV] = the Coefficient of Variation = [Std Dev] / [Average Mean]

   [Std Dev] = the standard deviation of 10 samples [Sample A - exposures 1 through 10]

   [Average Mean] = the average of 10 samples [Sample A - exposures 1 through 10]

   Sample A: _____

   Sample B: _____

9. Verify that the linearity for samples A and B is < 0.10 for HHS. (This is a pass or fail solution.)

   Calculation:

   ABS[(**avgmA**/Selected mAs) - (**avgmB**/Selected mAs) <= (0.1((**avgmA**/Selected mAs) + (**avgmB**/Selected mAs))]

   [**avgmX**] = the average of 10 samples [Sample X = exposures 1 through 10]

   Avg Mean Sample A = **avgmA** =_____

   Avg Mean Sample B = **avgmB** =_____

   Verify the linearity meets the regulatory limits.

7.1.5 Beam Quality Test

7.1.5.1 Measuring half value layer (HVL)

This test measures the combined HVL of the tube and collimator.

1. See Figure 7-5. Using a probe holder, position the probe a minimum of 30 cm (12 in) from a flat level surface (to avoid scatter) and 30 cm (12 in) from the X-ray beam output port (collimator).
2. Collimate the beam down to just cover the receptor of the dose probe.

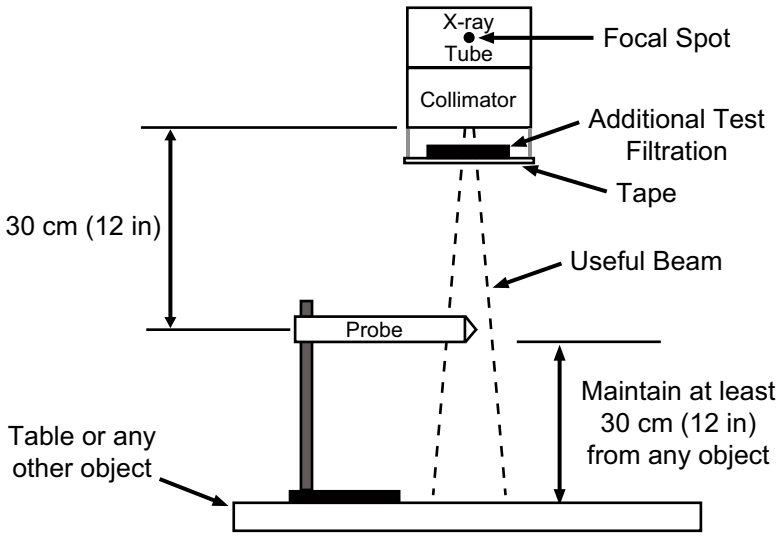


Figure 7-5 HVL test setup

3. Select kVp of 80, mAs of 12.5.
4. Remove or dial out all filters that are removable by the operator and collimate slightly larger than the active volume of the probe using the light field.
5. Make an exposure and measure exposure with no added filters. Record the reading.

   Exposure (without additional filtration) _____

   This represents 100% transmission level.
6. Place 3 mm additional filtration (using filters from HVL Attenuator, GE p/n 46-194427P274, total aluminum filtration = 3.0 mm) in beam. Additional filtration must be as close to the source as possible. Affix to the collimator rails using masking tape. Ensure tape does not encroach upon the usable beam.
7. Make an exposure with additional filtration. Record the reading.

   Exposure (with additional filtration) _____
8. Determine the ratio.

   Ratio = _____ Exposure (with additional filtration) / Exposure (without additional filtration)

Note: The ratio of Exposure (with additional filtration) to Exposure (without additional filtration) shall be equal to or greater than 0.5.

9. Enter the beam quality data in Table 7-17.

Table 7-17 Beam quality data (half value layer)

Radiation Reading		Ratio (with/without)	Aluminum Filtration Value	Manufacture Date
With Additional Filtration	Without Additional Filtration			
			3.0 mm	

7.1.6 Testing generator operator indicators

7.1.6.1 Testing tones, buzzers, and the X-ray ON indicator

1. On the system touchscreen, start an exam and select an exposure.
2. Make the exposure.
3. Verify that an X-ray tone sounds and the X-ray ON indicator illuminates during the exposure.
4. Verify that the selected kVp and mAs are displayed in the protocol modification frames and the left side of the status bar. Both displays should match.

7.1.6.2 Testing the heat unit alarm

1. Change the generator configuration of the Tube HUR Alarm to 95%. Select **COMMIT**.
2. Reset the system.
3. Make X-ray exposures (use appropriate radiation safety procedures, i.e. close collimator blades, etc.):
   - 80kVp
   - 40mAs
4. When the Heat Units go below 95%, a tone is heard.
5. Return the Tube HUR Alarm to 20% (default). Select **COMMIT**.
6. Reset the system.

Section 7.2 Testing electrical safety

Perform ground resistance testing & leakage testing only in the cases outlined in Table 7-18**.**

Site location	Perform ground testing?	Perform leakage testing?
Within the United States	Yes, if you replace a damaged plug or power cord or incoming AC circuitry.	Yes
Outside of the United States	Yes, if you replace the standard U.S. style plug with a regionally compliant plug, or if you replace a damaged plug or power cord or incoming AC circuitry.	Yes

Table 7-18 Test requirements

7.2.1 Performing ground resistance testing

Ground resistance testing must be performed if the AC power plug has been replaced or disturbed.

DANGER

RISK OF ELECTRIC SHOCK
Voltage present!
Disconnect the AC charging plug from any wall outlet power source.

7.2.1.1 Gathering test equipment

Obtain a Hioki 3157 grounding tester or equivalent. For sites in Europe, use the cables that are provided with the Hioki tester. For sites outside of Europe, obtain the following:

- Two green/yellow ground stranded wire cables:
  - Cable A = 2.5 mm² (12 AWG), 3 m (9.8 ft)
  - Cable B = 2.5 mm² (12 AWG), 5 m (16.4 ft)
- Two lugs to fit 0.64 cm (0.25 in) terminals to the meter end of each cable (Figure 7-6).
- Two clamps to fit onto the other end of the cables (Figure 7-6).

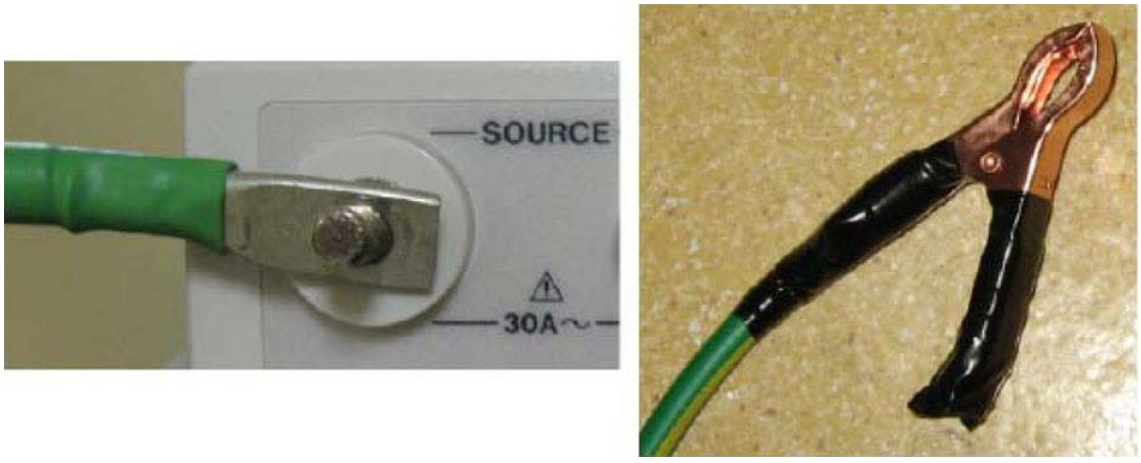


Figure 7-6 Lug and clamp on ground wire

7.2.1.2 Attaching test cables

1. On the tester, loosen both the current output (Source) terminal knob (top right) and the voltage measurement (Sense) terminal knob (bottom right) by turning them counterclockwise.
2. Connect Cable B to the current output knob.
3. Connect the short bar between the current output and voltage measurement knobs as shown in Figure 7-7.

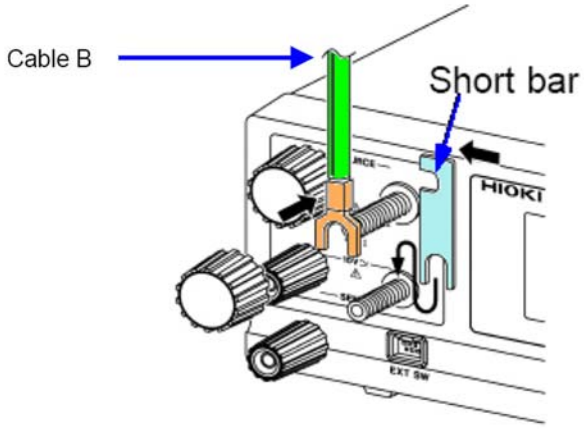


Figure 7-7 Test Cable B and short bar installation

4. Turn the two knobs clockwise to tighten.
5. Loosen the other current output (Source) terminal (top left), attach Cable A, and retighten the knob.

   The resulting connections should look as shown in Figure 7-8.

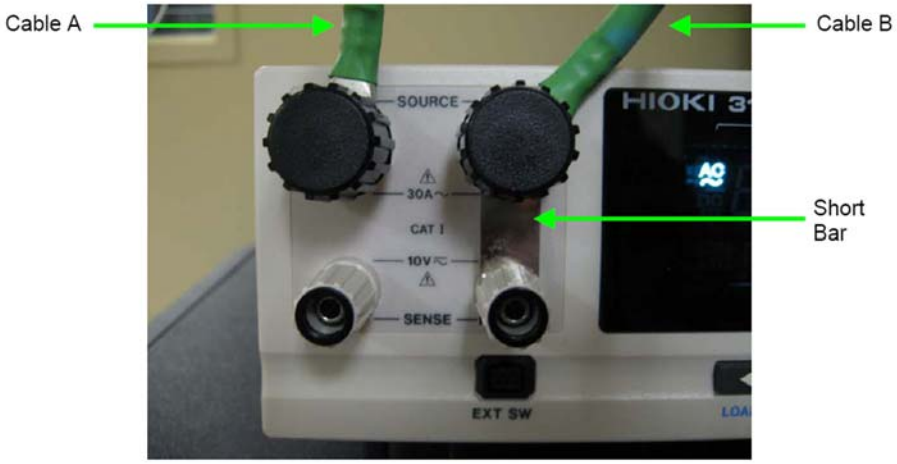


Figure 7-8 Cable A, Cable B, and short bar connections

7.2.1.3 Setting test parameters

1. Turn on the tester by pressing the **POWER** button.

   The tester enters the ready state five seconds after startup (the model name and version display during startup).

2. Verify that the tester displays the test parameters specified in Table 7-19.

Test parameters	Values
Current	Canada: 30.0 A All other countries: 25.0 A
Test value	0.100 Ohms
Timer	5.0 sec

Table 7-19 Ground resistance test parameters

If it does not, perform the following steps to change the parameters as needed (the system will save the settings even after system power is turned off). See Figure 7-9.

A. While in the ready state, press the ◄ or ► button until the output current display begins flashing.

B. Press the ▲ or ▼ button to change the output current. The value changes in 0.1-A increments. To change the value by 1.0-A increments, press SHIFT + ▲ or ▼ button.

C. Press the ► button again to move to each of the other settings (Maximum Test Value, Timer, and Frequency).

D. Use the ▲/▼ or SHIFT + ▲/▼ buttons as needed to adjust the values.

E. Press STOP.

Figure 7-9 Test parameter value settings

3. While in the ready state, press the SHIFT + STOP buttons to display the Optional function setting screen.

   The Output Current Frequency is the first digit displayed, where the value is 0 for 50 Hz or 1 for 60 Hz. The Pass/Fail hold function is represented by the second digit.

4. Press the ◄ or ► button until the second digit begins flashing.

5. Press the ▲ button to change the value to **1** (Figure 7-10).

6. Press the SHIFT + STOP buttons to save this setting and return to the ready state. The unit will display and hold the measured resistance value after the test.

Figure 7-10 Current setting on the tester

7.2.1.4 Performing zero adjustment

Ground measurements may be affected by a voltage drop in the A and B cables. To account for the voltage drop, perform the zero adjustment procedure before taking ground measurements.

1. Confirm that the unit is in the ready state.
2. Short circuit cable A with cable B.

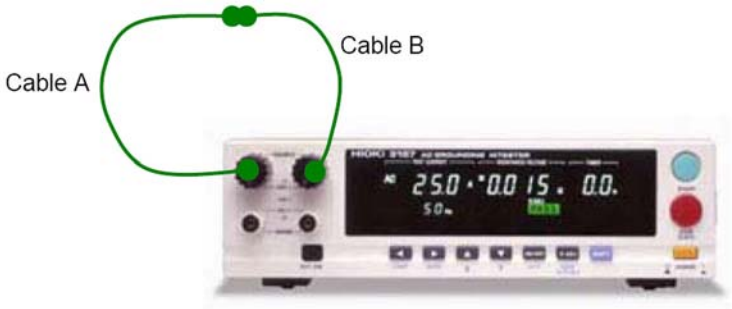


Figure 7-11 Cable A and cable B short-circuited

3. Press the 0 ADJ button.

   The orange test indicator is displayed, the 0ADJ indicator begins flashing below the resistance value, and the zero adjustment begins. During the zero adjustment, a preset current is output through the shorted leads. When zero adjustment is complete (about three seconds), the unit enters the ready state, and the 0ADJ lamp lights.

   If the test cables are too resistive, the offset cannot be set. Use less-resistive cables and try to set the offset again. The zero adjustment function is automatically disabled if the output current value is changed or if data settings are changed.

   Zero adjustment is possible within a range equivalent to a resistance between 0.000 Ohms and 0.100 Ohms on the resistor indicator. If the measured value falls outside this range, the resistance value flashes, and the unit enters the ready state.

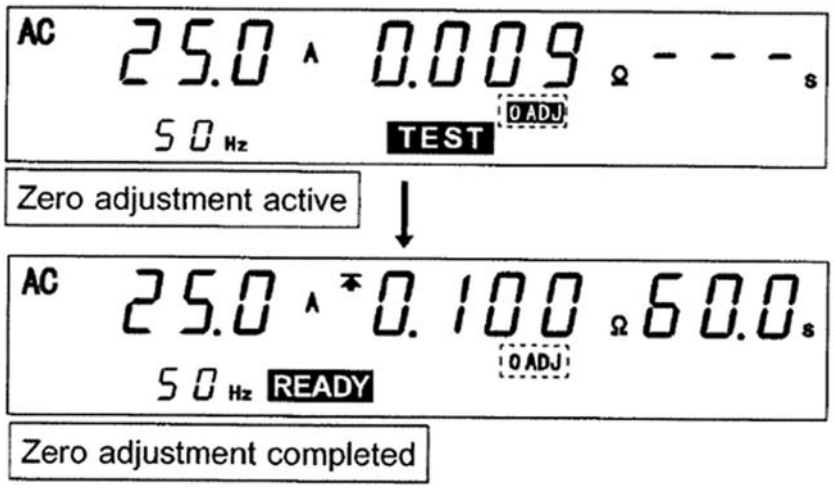


Figure 7-12 Tester during and after zero adjustment

7.2.1.5 Taking ground measurements

1. Turn off system power and main circuit breaker.
2. Connect cable A to the grounding pin on the electrical plug.
3. Connect cable B to the first measurement point listed in Table 7-20.
4. On the tester, press the green **START** button.

   The orange indicator is displayed, the Test Current display value quickly increases from 0.0 to the preset output current (25.0 A or 30.0 A), and the timer value decreases from 5.0 seconds to 0.0 seconds.

   If the test passes, the green Pass indicator is displayed. Record the displayed resistance value in Table 7-20.
5. Press **Stop**.
6. Move cable B to the next measurement (Table 7-20), then repeat steps 4 and 5.
   The voltage must not exceed 2.5 V (0.1 ohms).

Component	Measurement point	Measured resistance
Tube	Tube endcap screws or HV cable nuts See Figure 7-13	
Collimator	Skin guards See Figure 7-14	
Column	Scroll support rivets See Figure 7-15	
Bin	Inside hinge screws of accessory access cover See Figure 7-16	
Tube latch	Tube latch on top cover See Figure 7-17	

Table 7-20 Ground measurement test points

Figure 7-13 Tube test points

Figure 7-14 Collimator test points

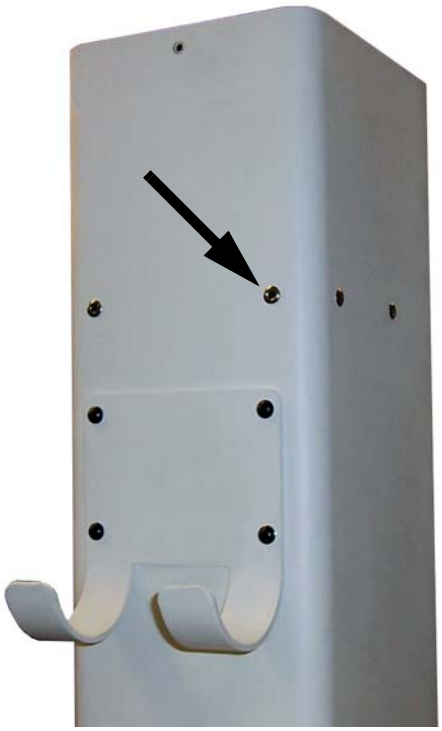


Figure 7-15 Column test point

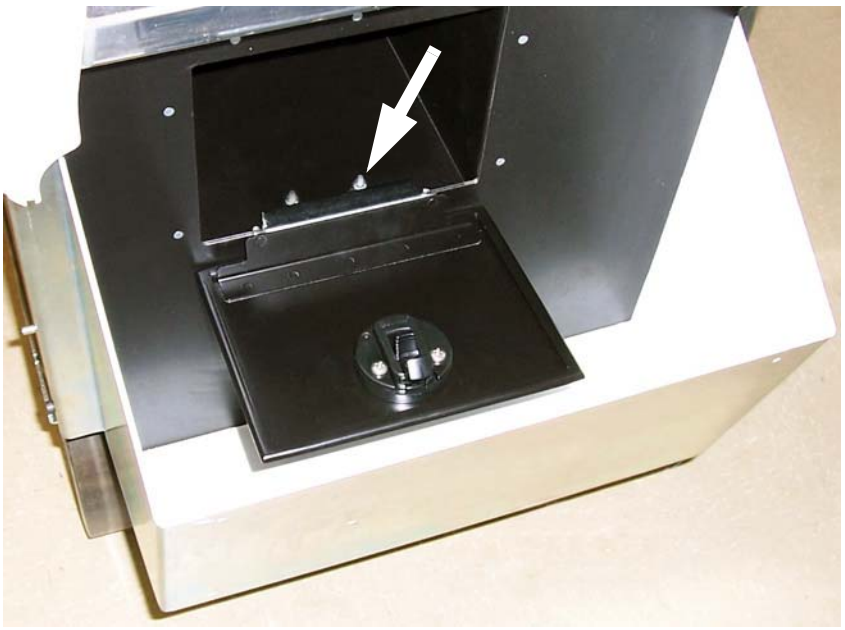


Figure 7-16 Rear bin accessory access cover test point

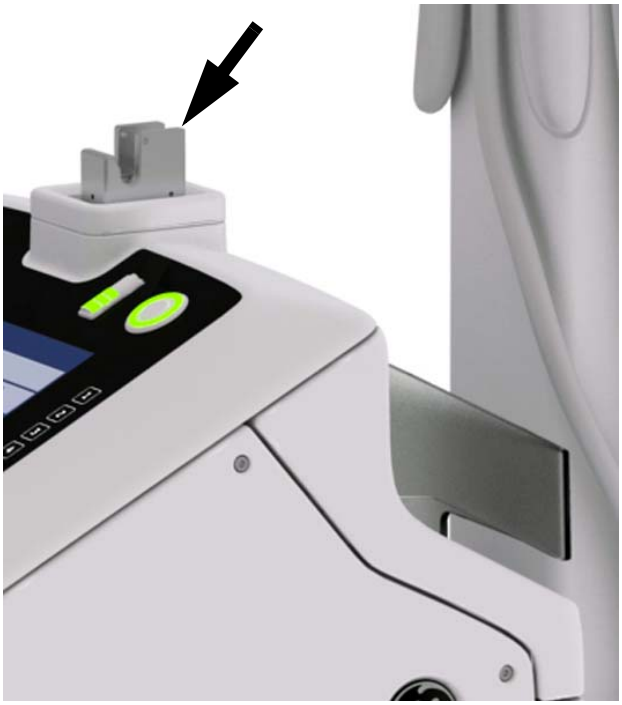


Figure 7-17 Tube latch test point

7.2.2 Performing leakage current testing

If ground testing is required for this system, verify that the ground testing results (see Table 7-20) are < 0.1 Ohms before conducting leakage testing.

Leakage testing must be performed if the AC power plug has been replaced or disturbed.

The leakage current must not exceed 300 uA.

Before you begin, verify these steps:

1. Complete ground testing, if required (see 7.2.1 Performing ground resistance testing on page 131).
2. Ensure that all system covers are installed.
3. Obtain a Dale 601/601E test meter or equivalent.

Perform leakage testing under the five specific conditions outlined in Table 7-21:

Condition	Power	Test meter outlet	X-ray on	Section reference
1	Off	Normal	No	7.2.2.1 Condition 1: Power off, normal outlet, X-ray off
2	Off	Reversed	No	7.2.2.2 Condition 2: Power off, reversed outlet, X-ray off
3	On	Normal	No	7.2.2.3 Condition 3: Power on, normal outlet, X-ray off
4	On	Reversed	No	7.2.2.4 Condition 4: Power on, reversed outlet, X-ray off
5	On	Normal	Yes	7.2.2.5 Condition 5: Power on, normal outlet, X-ray on

Table 7-21 Leakage current test conditions

NOTICE

Potential test equipment damage. Always pause in the OFF position when moving the OUTLET switch from NORMAL to REVERSED or REVERSED to NORMAL. Failure to do so can result in the internal test meter failure and tripping of facilities circuit breakers.

7.2.2.1 Condition 1: Power off, normal outlet, X-ray off

1. Turn off the system power, main circuit breaker ON.
   On the test meter, set the Function switch to **ENCLOSURE LEAKAGE,** the L2 switch to **CLOSED**, the Outlet switch to **Normal** and the M.A.P/Lift Gnd to **OFF** (Figure 7-18).

Figure 7-18 Dale 601 meter

2. Insert the black coil cord with clamp into the **CHASSIS** connection located on the top of the test meter (Figure 7-19).

Figure 7-19 Dale 601 meter, top view

3. Connect the Dale 601 test meter to a wall outlet.
4. **Important!** Connect the System AC power cord to the receptacle on the test meter.
5. Using the clamp, connect to all conductive surfaces listed in Table 7-22. Record the readings.

   Readings should be close to 0.0. Address high readings by checking for damaged ground wire or internal system wiring that could be causing current to flow to the tested component or chassis.

Conductive surface	Condition 1: Power off, normal outlet, X-ray off	Condition 2: Power off, reversed outlet, X-ray off	Condition 3: Power on, normal outlet, X-ray off	Condition 4: Power on, reversed outlet, X-ray off	Condition 5: Power on, normal outlet, X-ray on
	Leakage current				
Tube					
Collimator					
Column					
Bin					
Tube latch					

Table 7-22 Leakage current test results

7.2.2.2 Condition 2: Power off, reversed outlet, X-ray off

1. On the test meter, set the Outlet switch to **Reversed**.
2. Verify the system power is OFF, main circuit breaker ON.
3. Using the clamp, connect to all conductive surfaces.
4. Record the readings in Table 7-22.

7.2.2.3 Condition 3: Power on, normal outlet, X-ray off

1. Turn on the system power.
2. On the test meter, set the Outlet switch to **Normal**.
3. Using the clamp, connect to all conductive surfaces.
4. Record the readings in Table 7-22.

7.2.2.4 Condition 4: Power on, reversed outlet, X-ray off

1. On the test meter, set the Outlet switch to **Reversed**.
2. Verify that system power is on.
3. Using the clamp, connect to all conductive surfaces.
4. Record the readings in Table 7-22.

7.2.2.5 Condition 5: Power on, normal outlet, X-ray on

WARNING

EXPOSURE TO RADIATION
Wear a lead vest to protect yourself from radiation.

1. On the test meter, set the Outlet switch to **Normal**.
2. Verify that system power is on.
3. Make an exposure (see Table 7-23) while using the clamp to connect to all conductive surfaces.

Generator power	kVp	mAs
15 kW	125	100
30 kW	125	100

Table 7-23 Exposure technique

4. Record the readings in Table 7-22.

Section 7.3 Tube Radiation Leakage Test - Optional

7.3.1 Personnel Requirements

Required persons: 1
Timing (min): 90 including setup and clean up

7.3.2 Preliminary requirements

7.3.2.1 Tools and test equipment

- RTI Piranha model 657 with R100, R100B or Piranha Dose probe as provided by the vendor (or equivalent)

- 3 mm lead to block the primary beam
- Metric tape measure

7.3.2.2 Consumables

- None

7.3.2.3 Safety

- Appropriate ionizing radiation PPE

7.3.3 Purpose

The purpose of this section is to provide guidance and definition for those that wish to perform a radiation leakage test of the X-ray tube/collimator assembly (also known as "source assembly").

Per the technical data sheet, the Leakage Technique Factor is 150 kV, 0.4 mA.

This is used by Toshiba for their bench testing.

The technique for this mobile system is 125 kV, 250 mAs.

The details as to why and how are explicitly defined at the end of this section.

This content applies to the Optima XR220amx, Optima XR200amx, Optima XR200 with Digital Upgrade, and the Brivo XR285amx products.

7.3.4 Common Errors:

- The most common error identified is incorrect meter settings. Many test meters have the ability to perform what they define as “Dose Rate”, “Dose Accumulate” or some similar verbiage measurements. However, these settings are not applicable to our system as described above. **Ensure your test meter is configured for a single measurement and zeroed as applicable. Reset the meter for each subsequent exposure.**
- Another common error is poor positioning of the probe. Care should be taken to ensure the probe is positioned perpendicular to the focal spot at a 1 meter distance. See Figure 7-20.
- Ensure the collimator blades are closed and block the collimator port with at least 10 HVL equivalence of lead (3 mm or more) to block the primary beam limiting scatter radiation noise in the readings. See Figure 7-20.
- Ensure your units of measure conversions are correct.

7.3.5 X-Ray Tube Leakage Radiation Requirement:

Tube Leakage Radiation < 0.88 mGy/hr at 1m from focal spot (125 kV, 250 mAs)

GE Rejection limit < 0.80 mGy/hr at 1m from focal spot (125kV, 250mAs)

This rating is applicable at the Long-Term Maximum Input Power rating. Multiply the measured leakage of each 125 kV, 250 mAs exposure (in mGy) by 6.9 to determine the leakage radiation of each exposure at this power level.

Repeat measurements as needed, one exposure at different locations, each at 1 meter from the focal spot. See Figure 7-20 and Figure 7-21. It is also recommended that 520 seconds between exposures is observed for tube thermal considerations. These readings are not cumulative.

The integration value (IV/hr) is determined with the following formula;

(3600 sec/hour) x Continuous mA / desired mAs = Integration Value (IV)/hr
(3600 sec/hour) x 0.48 mA / 250 mAs = 6.912 / hr

Calculate the Leakage reading by the following formula;

Integrated Leakage Reading = Measured dose x IV/hr
Integrated Leakage Reading = Measured dose x 6.9

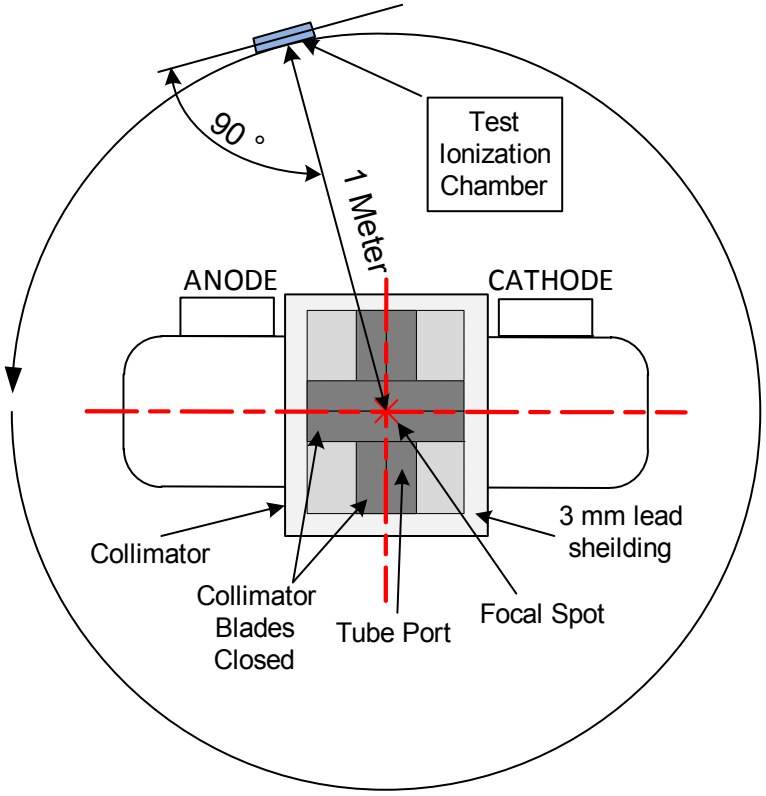


Figure 7-20 Test tool setup

Figure 7-20 illustrates the positioning of the test tool (ionization chamber) in 2 dimensions only. Ensure the ionization chamber is perpendicular to the source in each dimension for accurate readings. The testing parameters per 21CFR 1020.30 define that this test should be performed in “1 meter in any direction from the source” (3 dimensionally). Also stated is the following; “Compliance shall be determined by measurements averaged over an area of 100 square cm with no linear dimension greater than 20 cm.” This statement defines the maximum size of the Ionization Chamber that should be used.

Figure 7-21 illustrates the approximate position of the Toshiba Rotanode™ E7894X X-ray Tube assembly utilized with these defined products.

Note: When making these measurements, it is common to see the highest readings relative to the anode side of the tube.

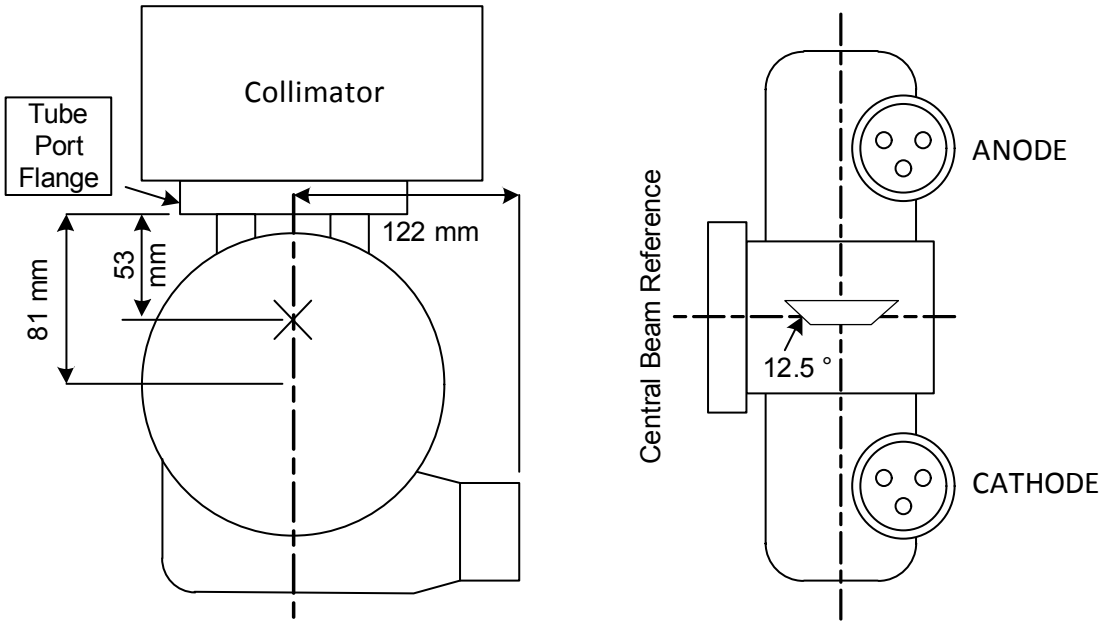


Figure 7-21 Model E7894X Focal Spot Reference (Drawings not to scale) See OEM data sheet for details

Background:

The Optima XR220amx, Optima XR200amx, Optima XR200amx with Digital Upgrade, and the Brivo XR285amx products are battery operated systems and not capacitive discharge or field emission systems. Therefore, per regulatory requirements (21CFR 1020.30 being the most stringent), we fall under the “For all other diagnostic source assemblies” category.

Per 21CFR, the leakage radiation from the diagnostic source assembly shall not exceed 0.88 mGy air kerma in 1 hour. In our system, we are not capable of performing continuous exposures for this time frame. Therefore, an integrated leakage reading would be desired. However, the system design is such that independent mA and time control is not possible. It is a two point system interface design. Additionally, most exposures are sub-second in length approaching the test meters capabilities.

The maximum rated tube potential is 125 kVp for the following products;

- Optima XR220amx
- Optima XR200amx
- Optima XR200amx with Digital upgrade
- Brivo XR285amx

The maximum continuous tube current is defined by the “continuous anode input power” found in the tube technical data sheet. Per Toshiba, for the E7894X tube, the average anode power is 60 watts. Knowing the average anode power is 60 W and the max kVp is 125, we then get;

60 W / 125 kVp = 0.48 mA continuous

For testing purposes, a radiographic exposure is used and the leakage measured for that exposure.
The technique used for measurement is a rad exposure of 125 kVp, 250 mAs.
The actual values for the 30 kW systems are 125 kVp at ~77.01 mA and ~ 3.246 seconds.
The actual values for the 15 kW systems are 125 kVp at ~64.39 mA and ~3.883 seconds.
Using these actual values the duty cycle (IV/hr) becomes 6.9 exposures per hour.

The exact mA and time used to get 250 mAs on a 30 kW versus the 15 kW systems may be different, but the mAs ratio relative to continuous 0.48 mA at 125 kVp calculate to be the same.

Chapter 8 Replacement procedures

HAZARDS EXIST

THE POTENTIAL FOR INJURY OR DEATH FROM ELECTRICAL AND MECHANICAL HAZARDS IS HIGH. CAREFULLY READ AND FOLLOW INSTRUCTIONS. ALWAYS LOTO THE SYSTEM BEFORE ATTEMPTING SERVICE OF ANY KIND, AS DESCRIBED IN Chapter 1 Safety / Before You Begin**.**

Section 8.1 Cover management

8.1.0.1 Personnel requirements

Required persons: 1

Timing (min): Depends on cover

8.1.0.2 Preliminary requirements

8.1.0.2.1 Tools and test equipment

- Standard tool kit
- Security Torx screw bit = 5427920

8.1.0.2.2 Consumables

- None

8.1.0.2.3 Replacement parts

Item: Cover

Quantity: Depends on cover

8.1.0.2.4 Safety

- None

8.1.0.2.5 Required conditions

- None

8.1.1 Side cover removal

1. Loosen the 5 fasteners on the side cover(s) to be removed. See Figure 8-1.
2. Remove the side cover(s).

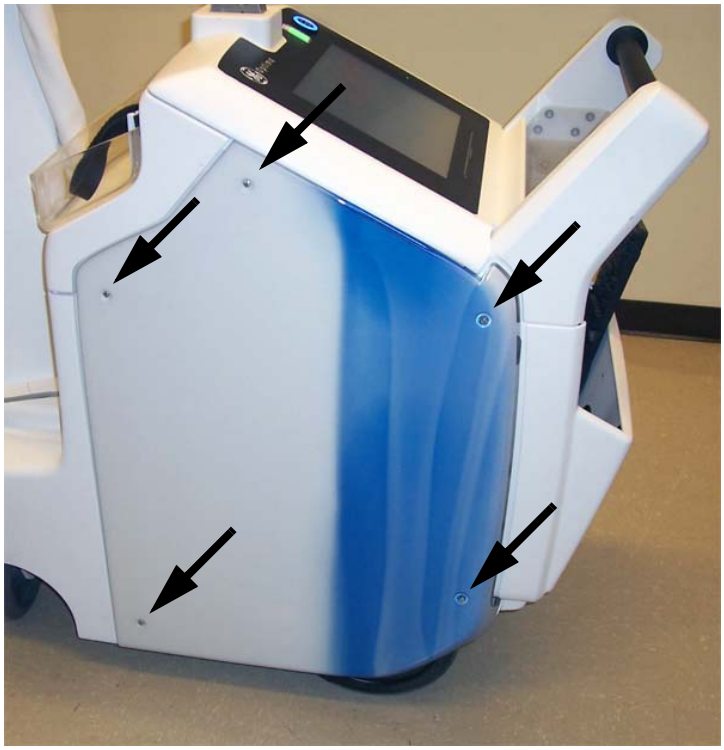


Figure 8-1 Side cover screws (left side shown)

8.1.2 Top cover removal

1. Remove the side covers. See Section 8.1.1 Side cover removal.
2. Remove the 3 cap screws from each side of the top cover. See Figure 8-2.

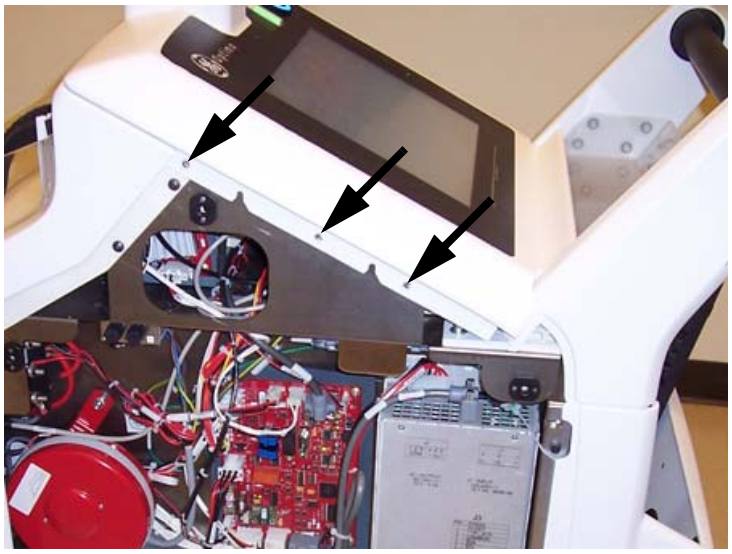


Figure 8-2 Top cover screws

3. Lift the top cover and disconnect the 3 cables. See Figure 8-3.

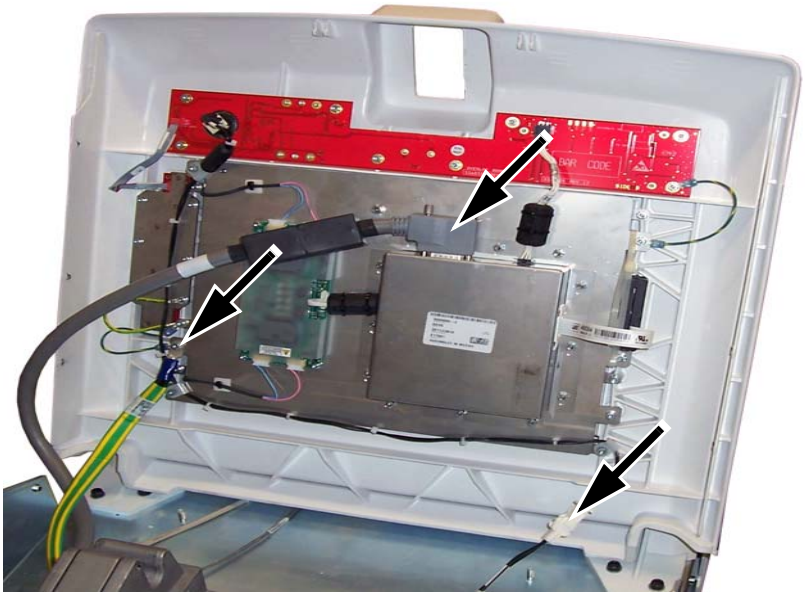


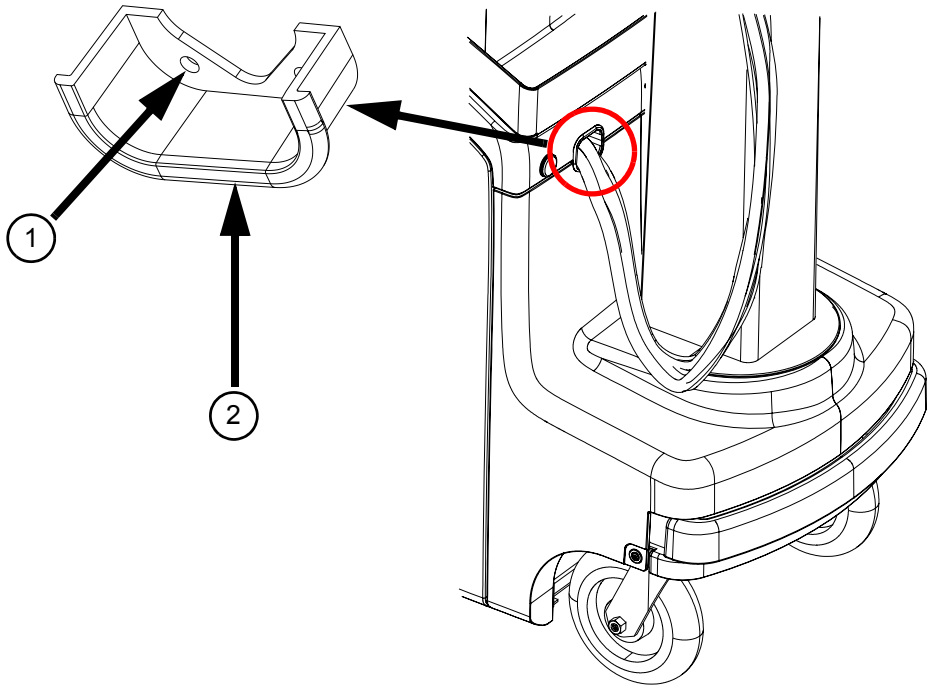
Figure 8-3 Top cover cables

4. Remove the top cover.

8.1.3 Front cover removal

8.1.3.1 Right front cover removal

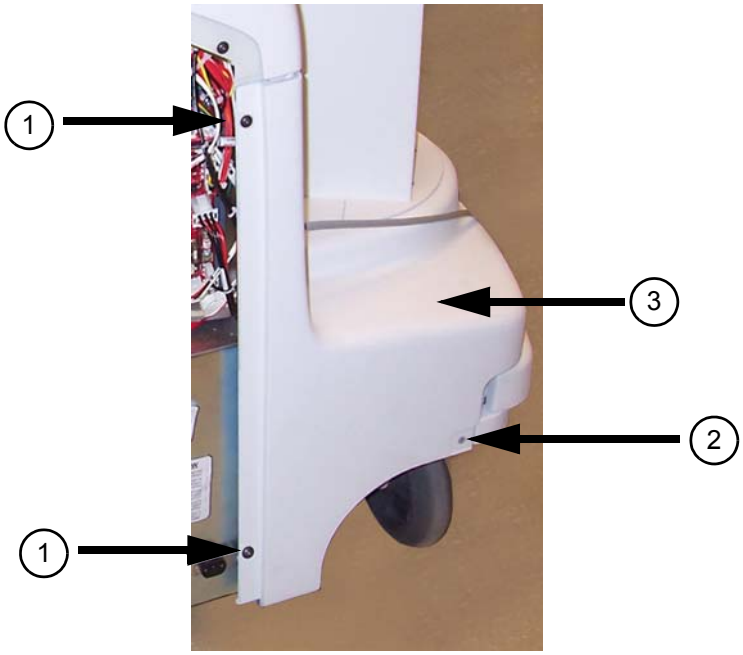
1. Remove the right side cover. See Section 8.1.1 Side cover removal.
2. See Figure 8-4. Remove the 2 mounting screws (Item 1) from the bottom cable exit cover (Item 2).



Item	Description
1	Mounting screws (2 used)
2	Bottom cable exit cover

Figure 8-4 Bottom cable exit cover

3. Remove 2 mounting screws (Item 1) from the side of the cover. See Figure 8-5.



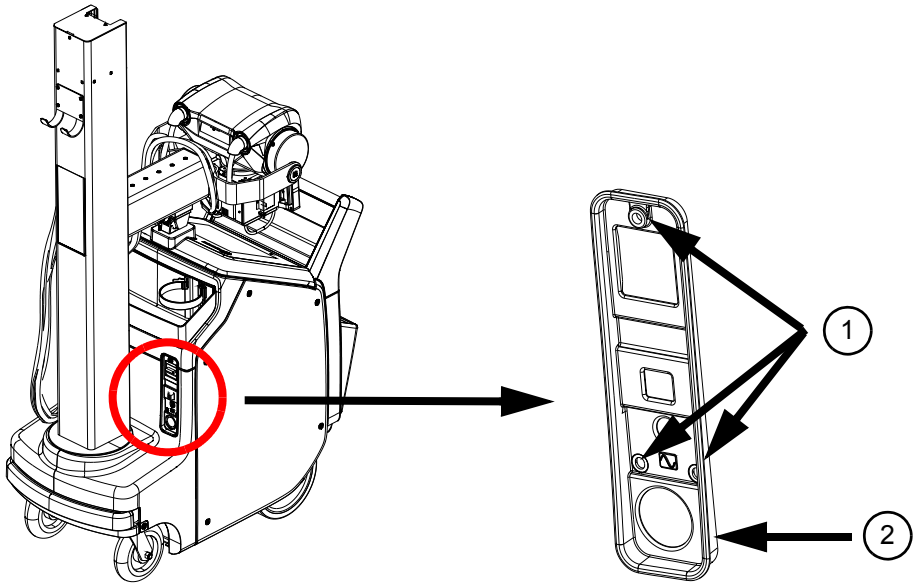
Item	Description
1	Rear mounting screws (2 used)
2	Front mounting screw (1 used)
3	Right front cover

Figure 8-5 Right front cover

4. Remove 1 mounting screw (Item 2) at the front of the cover.
5. Slide the cover sideways to remove.

8.1.3.2 Left front cover removal

1. Remove the left side cover. See Section 8.1.1 Side cover removal.
2. Remove the 3 mounting screws (Item 1) from the breaker tray (Item 2). See Figure 8-6.

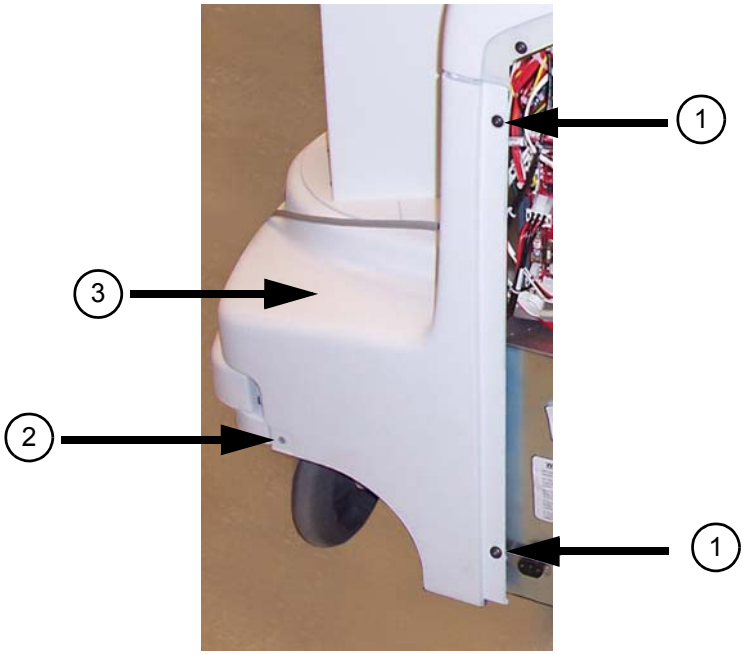


Item	Description
1	Mounting screws (3 used)
2	Breaker tray

Figure 8-6 Breaker tray

3. Remove the breaker tray.

4. Remove 2 mounting screws (Item 1) from the side of the cover. See Figure 8-7.



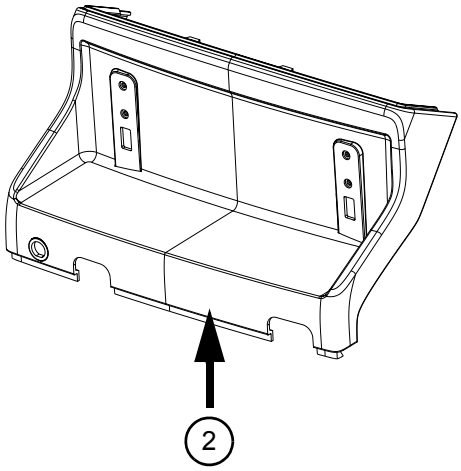
Item	Description
1	Rear mounting screws (2 used)
2	Front mounting screw (1 used)
3	Left front cover

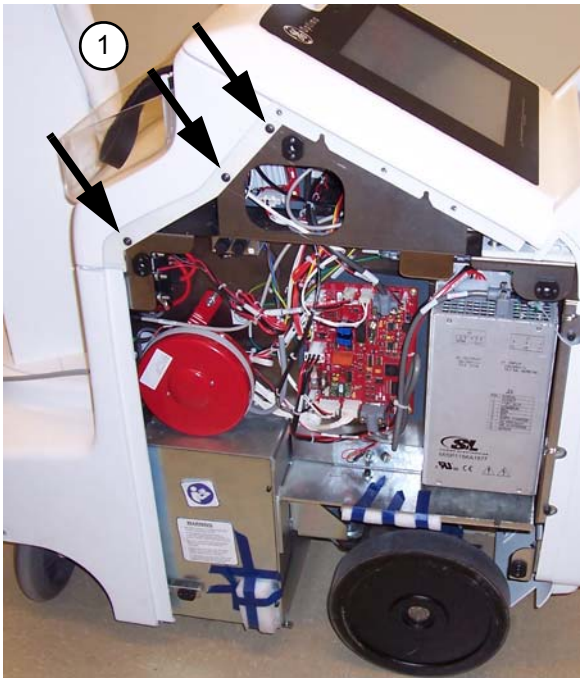
Figure 8-7 Right front cover

5. Remove 1 mounting screw (Item 2) at the front of the cover.
6. Slide the cover (Item 3) sideways to remove.

8.1.4 Front bin removal

1. Remove the side covers. See Section 8.1.1 Side cover removal.
2. Remove the 3 cap screws on each side of the top cover, but do not disconnect any cables. Leave the top cover in place. See Section 8.1.2 Top cover removal.
3. Remove the 3 cap screws (Item 1) on each side of the front bin (Item 2). See Figure 8-8.

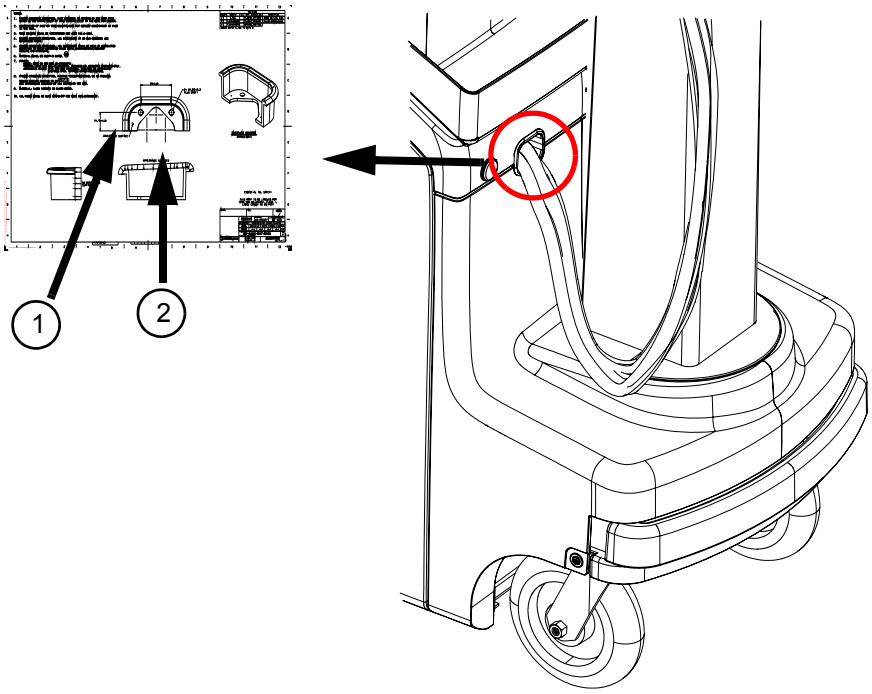




Item	Description
1	Mounting screws
2	Front bin

Figure 8-8 Front bin

4. See Figure 8-9. Remove the 2 mounting screws (Item 1) from the top cable exit cover (Item 2), then remove the cover.



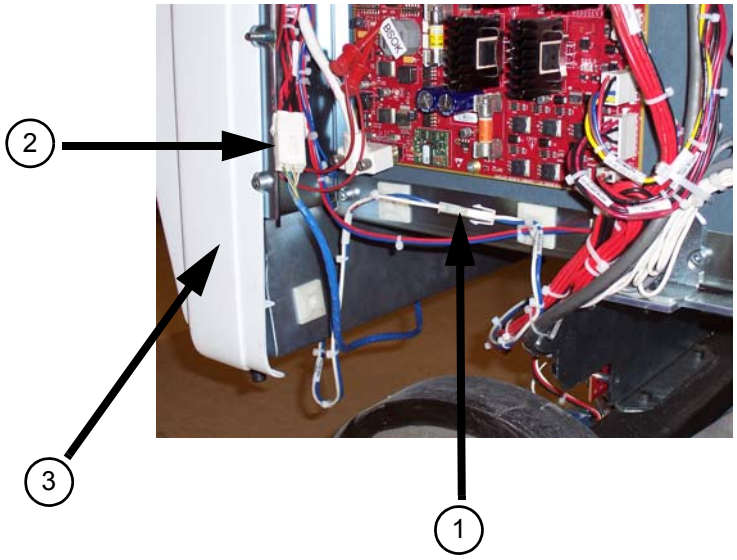
Item	Description
1	Mounting screws (2 used)
2	Top cable exit cover

Figure 8-9 Cable exit covers

5. Slightly lift the rear of the top cover to clear the lip on the front bin.
6. Remove the front bin.

8.1.5 Rear bin removal

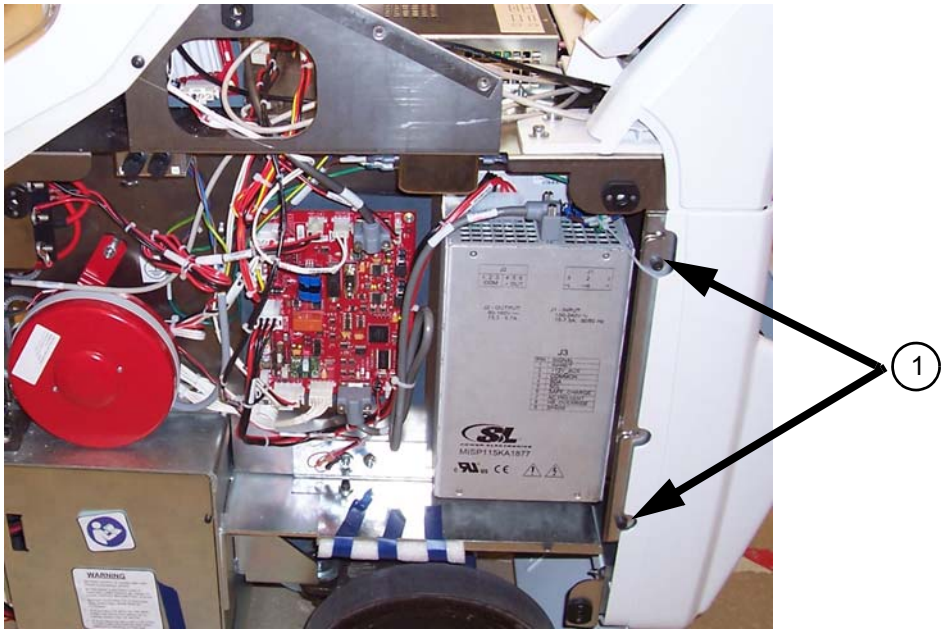
1. Remove the side covers. See Section 8.1.1 Side cover removal on page 150.
2. See Figure 8-10. For Optima XR220amx or Optima XR200amx with digital upgrade, disconnect the 2 cables (Items 1 and 2) at the right-side bottom of the rear bin (Item 3).



Item	Description
1	Cable Assy - Detector Park Switch to Bulkhead
2	Cable Assy - Detector Charge to Bulkhead
3	Rear bin

Figure 8-10 Optima XR220amx or Optima XR200amx with digital upgrade rear bin cables

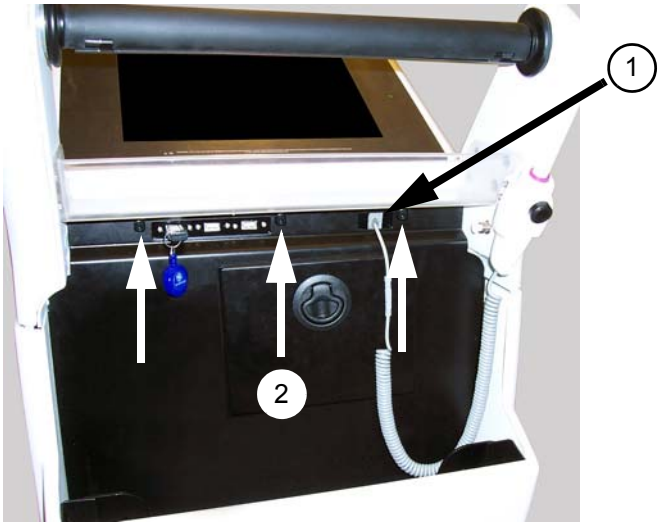
3. See Figure 8-11. Remove the 2 side mounting screws (Item 1) on each side of the rear bin.



Item	Description
1	Rear bin side mounting screws

Figure 8-11 Rear bin side mounting screws

4. See Figure 8-12. Disconnect the exposure switch cable (Item 1).



Item	Description
1	Exposure switch connector
2	Rear bin top mounting screws (3 used)

Figure 8-12 Rear bin top mounting screws

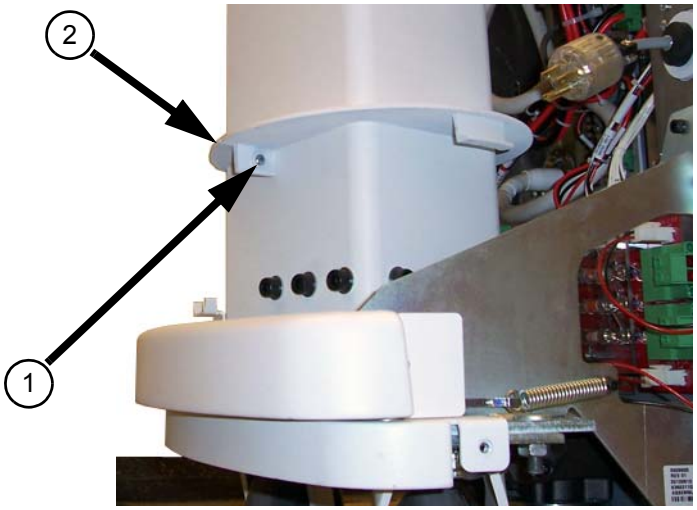
⚠ CAUTION

HEAVY WEIGHT
The rear bin is heavy. Support the bin when removing the screws and lifting the bin off of the chassis.

5. Remove the three mounting screws (Item 2) at the top of the rear bin.
6. Remove the rear bin.

8.1.6 Column skirt cover removal

1. Remove the left side cover and left front cover. See Section 8.1.3 Front cover removal.
2. Rotate the tube column to access one of the mounting screws (Item 1), then remove the mounting screw. See Figure 8-13.



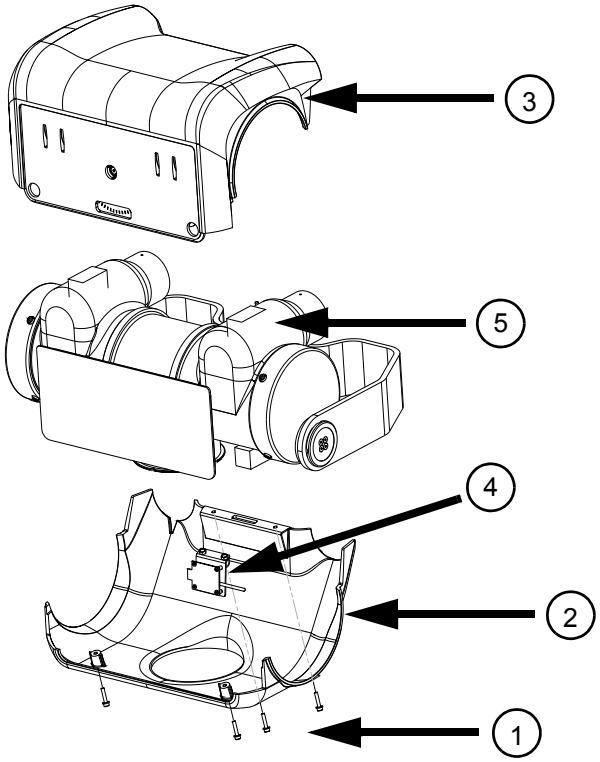
Item	Description
1	Mounting screw
2	Column skirt cover

Figure 8-13 Column skirt cover

3. Rotate the tube column to access and remove the other mounting screw.
4. Remove the column skirt covers (Item 2).

8.1.7 Tube head cover removal

1. If the lower tube cover needs to be removed, the collimator must be removed first. See Section 8.6.9 Collimator.
2. See Figure 8-14. Remove the 4 mounting screws (Item 1) from the bottom of the lower tube cover (Item 2). The collimator can be rotated to provide access to the screws.



Item	Description
1	Safety Torx screws (4 used)
2	Lower tube cover
3	Upper tube cover
4	Wireless USB Host Radio Board
5	X-ray tube

Figure 8-14 Tube covers

3. Remove the upper tube cover (Item 3).
4. Unplug the USB cable from the Wireless USB Host Radio Board (Item 4) - Optima XR220amx or Optima XR200amx with digital upgrade only.
5. Remove the lower tube cover (Item 2).

Section 8.2 Cable replacement

8.2.1 General cable replacement

8.2.1.1 Personnel requirements

Required persons: 1

Timing (min): Depends on cable

8.2.1.2 Preliminary requirements

8.2.1.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.2.1.2.2 Consumables

- Cable ties

8.2.1.2.3 Replacement parts

Item: Cable

Quantity: Depends on cable

8.2.1.2.4 Safety

- None

8.2.1.2.5 Required conditions

- Remove covers to access the desired cable. See Section 8.1 Cover management.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.2.1.3 Procedure

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Mark the location of all cable restraints on the old cable.
2. Cut or remove the cable restraints from the old cable.
3. Disconnect and remove the old cable.
4. Transfer the locations of the cable restraint marks from the old cable to the new cable.
5. Install and connect the new cable.
6. Install the cable restraints on the new cable.
7. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
8. Install the covers.

8.2.1.4 Finalization

See Table 8-1 to determine required tests.

Table 8-1 Test matrix for cable replacement

Cable being replaced	Tests that must be performed
Aux Box to Rotor Cable Assembly (See 8.2.2 High voltage cable replacement on page 167 for the correct cable bundle arrangement for the HV cable clamp)	Functional Checks: • X-ray (see X-ray on page 36)
Aux Box to Rotor Jumper Cable	Functional Checks: • X-ray (see X-ray on page 36)
Col Bulkhead to DAP Cable Assembly (See 8.2.2 High voltage cable replacement on page 167 for the correct cable bundle arrangement for the HV cable clamp)	Functional Checks: • X-ray - Dose report (see X-ray on page 36)
Cable Assy- Spyder to Hornet	HHS Checks: • Generator operator indicators (see 7.1.6 Testing generator operator indicators on page 131)
Cable Assy- Spyder to Locust	Functional Checks: • Drive (see Drive on page 35)
Cable Assy- Spyder to Djinn	Functional Checks: • X-ray (see X-ray on page 36)
Cable Assy- Spyder to LVLE2	Functional Checks: • Charging (see Charging on page 35) • Drive (see Drive on page 35) • X-ray (see X-ray on page 36) • Light field buttons (see Collimator on page 34)
Cable Assy- Spyder to Firefly	Functional Checks: • Charging (see Charging on page 35)
Cable Assy - Spyder to Wired Handswitch	Functional Checks: • X-ray (see X-ray on page 36)
Cable Assy- LVLE2 to Firefly (there are 2 separate cables)	Functional Checks: • Charging (see Charging on page 35)
Cable Assy- Locust to LVLE2	Functional Checks: • Charging (see Charging on page 35) • Drive (see Drive on page 35) • X-ray (see X-ray on page 36) • Light field buttons (see Collimator on page 34)
Cable Assy- LVLE2 to Djinn	Functional Checks: • X-ray (see X-ray on page 36)
Cable Assy - LVLE2 to DPM-PC	Functional Checks: • X-ray (see X-ray on page 36), ensure images are created
Cable Assy- Locust to Caterpillar (there are 2 separate cables)	Functional Checks: • Drive (see Drive on page 35)

Table 8-1 Test matrix for cable replacement

Cable being replaced	Tests that must be performed
Cable Assy - Locust to Drive Handle	Functional Checks: • Drive (see Drive on page 35)
Cable Assy - Locust to Cricket	Functional Checks: • Drive - see Drive on page 35
Cable Assy - Hornet to Display	HHS Checks: • Generator operator indicators (see 7.1.6 Testing generator operator indicators on page 131)
Cable Assy - Mantis to Firefly (there are 2 separate cables)	Functional Checks: • Charging (see Charging on page 35)
Cable Assy - Cricket to Firefly (there are 2 separate cables)	Functional Checks: • Charging (see Charging on page 35)
Cable Assy - Cricket to Djinn	Functional Checks: • X-ray (see X-ray on page 36)
Cable Assy - Cricket to Breaker	Functional Checks: • Charging (see Charging on page 35) • X-ray (see X-ray on page 36)
Cable Assy - Locust to Park Latch	Functional Checks: • Drive (speed limited when tube not latched) (see Drive on page 35)
Cable Assy - Caterpillar to Bumper	Functional Checks: • Drive - see Drive on page 35
Cable Assy - Caterpillar to Rot Brake	Functional Checks: • Drive (brake solenoids) (see Drive on page 35) • Tube column & arm (locks & latches) (see Tube column and arm on page 35)
Cable Assy - Hornet to Inverter	HHS Checks: • Generator operator indicators (see 7.1.6 Testing generator operator indicators on page 131)
Cable Assy - Hornet to Overlay Board	HHS Checks: • Generator operator indicators (see 7.1.6 Testing generator operator indicators on page 131)
Cable Assy - Drive Login to Overlay Board	Functional Checks: • Drive (drive login) (see Drive on page 35)
Cable Assy - Firefly to Power Switch	Functional Checks: • Charging (see Charging on page 35)
Cable Assy - Firefly to CLS J1	Functional Checks: • Light field buttons (see Collimator on page 34)
Cable Assy - Firefly to CLS	HHS Checks: • Light field intensity (see 7.1.3.1 Testing light intensity on page 116)
Cable Assy - Mantis to Filter	Functional Checks: • Charging (see Charging on page 35)

Table 8-1 Test matrix for cable replacement

Cable being replaced	Tests that must be performed
Cable Assy - Fuse to Filter	HHS Checks: • Grounding (see 7.2.1 Performing ground resistance testing on page 131) • Leakage (see 7.2.2 Performing leakage current testing on page 141)
Cable Assy - Locust to Hard Brake Release	Functional Checks: • Drive (brake solenoids) (see Drive on page 35)
Cable Assy - DPS to PC-Backup Tether	Functional Checks: • X-ray (see X-ray on page 36), ensure images are created
Cable Assy - Locust to Thorax Column Bulkhead (See 8.2.2 High voltage cable replacement on page 167 for the correct cable bundle arrangement for the HV cable clamp)	Functional Checks: • Tube column & arm (locks & latches) (see Tube column and arm on page 35)
Cable Asm - Detector Power Supply to Detector charge cable (surge-limit cable assembly)	None
Cable Asm - Surge-limit cable assembly to Detector charge bin connector	None
Cable Assy - Spyder to Speaker	Functional Checks: • X-ray (sounds & tones) (see X-ray on page 36)
Cable Assy - Sypder to Thorax Column Bulkhead -DAP-	Functional Checks: • X-ray (dose report) (see X-ray on page 36)
Cable Assy - CLS to Thorax Column Bulkhead -Collimator-	HHS Checks: • Light field intensity (see 7.1.3.1 Testing light intensity on page 116)
Cable Assy - Spyder to Board Data Module	None
Cable Assy- Spyder to PC video cable	None
Cable Assy - Spyder to PC USB	None
Cable Assy - PC to Ethernet Bulkhead	None
Cable Assy - PC to USB Bulkhead	None
Cable Assy - PC to UWB Antenna (See 8.2.2 High voltage cable replacement on page 167 for the correct cable bundle arrangement for the HV cable clamp)	None
Cable Assy - Caterpillar interconnect harness to Detector Park Switch pigtail	Functional Checks: • Drive (speed limited in tethered mode (see Drive on page 35)
Cable Assy - Detector Park Switch pigtail to Caterpillar interconnect harness	Functional Checks: • Drive (speed limited in tethered mode (see Drive on page 35)
Cable Assy - Detector Bin Charge connector to interconnect cable from Surge Assembly	Functional Checks: • Drive (speed limited in tethered mode (see Drive on page 35)

Table 8-1 Test matrix for cable replacement

Cable being replaced	Tests that must be performed
Cable Assy - Spyder Dose Reporting to USB Bulkhead	None
Handswitch Cable - N9 Color	Functional Checks: • X-ray (see X-ray on page 36)

8.2.2 High voltage cable replacement

8.2.2.1 Personnel requirements

Required persons: 1

Timing (min): 60

8.2.2.2 Preliminary requirements

8.2.2.2.1 Tools and test equipment

- Standard tool kit

8.2.2.2.2 Consumables

- Cable ties

8.2.2.2.3 Replacement parts

Item: HV cable(s)

Quantity: 1 or 2

8.2.2.2.4 Safety

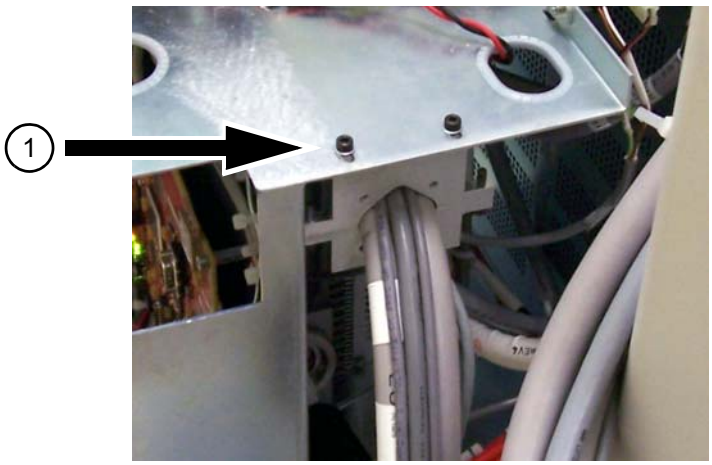
- None

8.2.2.2.5 Required conditions

- Remove the side covers and the front covers. See 8.1.3 Front cover removal.
- Remove the front bin. See 8.1.4 Front bin removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.2.2.3 Procedure

1. On the existing cable(s) to be replaced, mark the cable(s) at the position of each cable clamp and cable tie.
2. Remove the HV cable clamp mounting screws. See Figure 8-15.



Item	Description
1	HV cable clamp mounting screws (2)

Figure 8-15 HV cable clamp mounting screws

3. Remove the clamp from the HV cable bundle. See Figure 8-16.

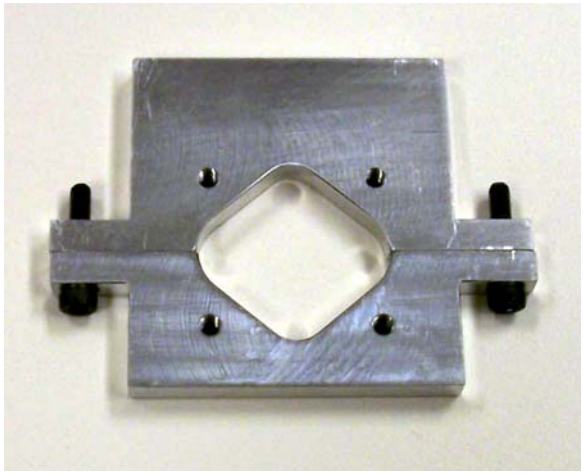
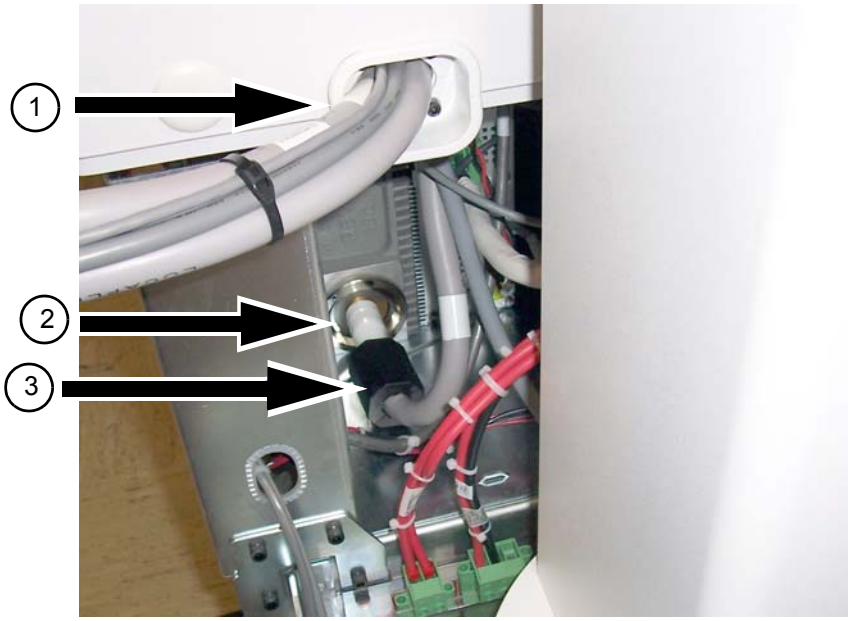


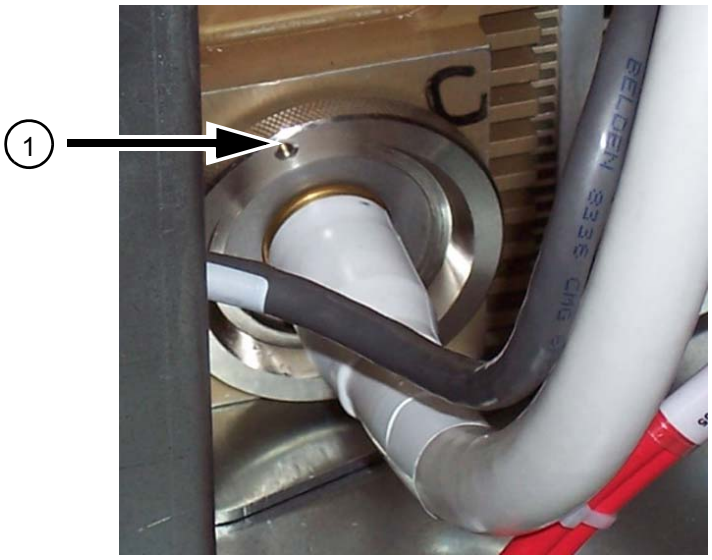
Figure 8-16 HV cable clamp

4. See Figure 8-17. Loosen the set screw(s) (see Figure 8-18) in the HV cable tightening ring(s) at the Djinn HV tank. Loosen and remove the tightening ring(s) and pull the cable(s) out of the tank.



Item	Description
1	Anode HV cable (not visible)
2	Cathode HV cable
3	Ferrite (one on each HV cable)

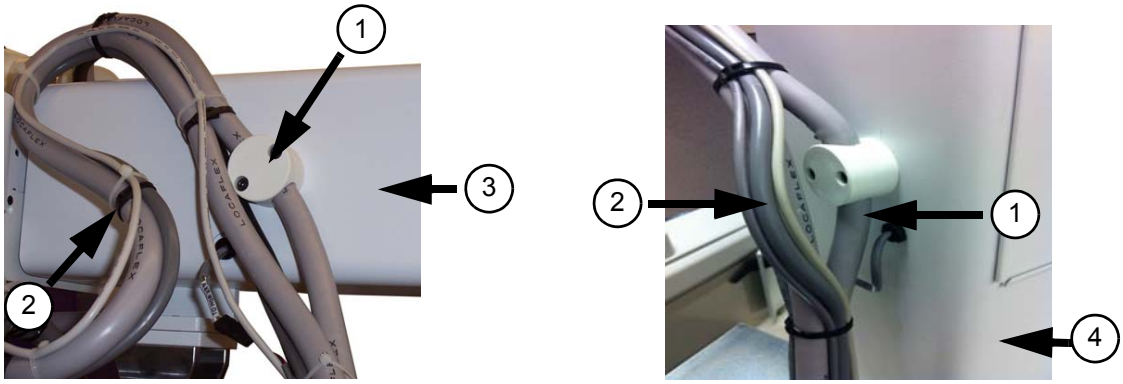
Figure 8-17 Djinn tank - HV cables



Item	Description
1	HV cable tightening ring set screw

Figure 8-18 Djinn tank - tightening ring set screw

5. See Figure 8-19. Remove the cable clamps (Item 1) from the side of the horizontal arm (Item 3) and vertical column (Item 4) and cut the cable ties (Item 2) from the cable(s) to be replaced.



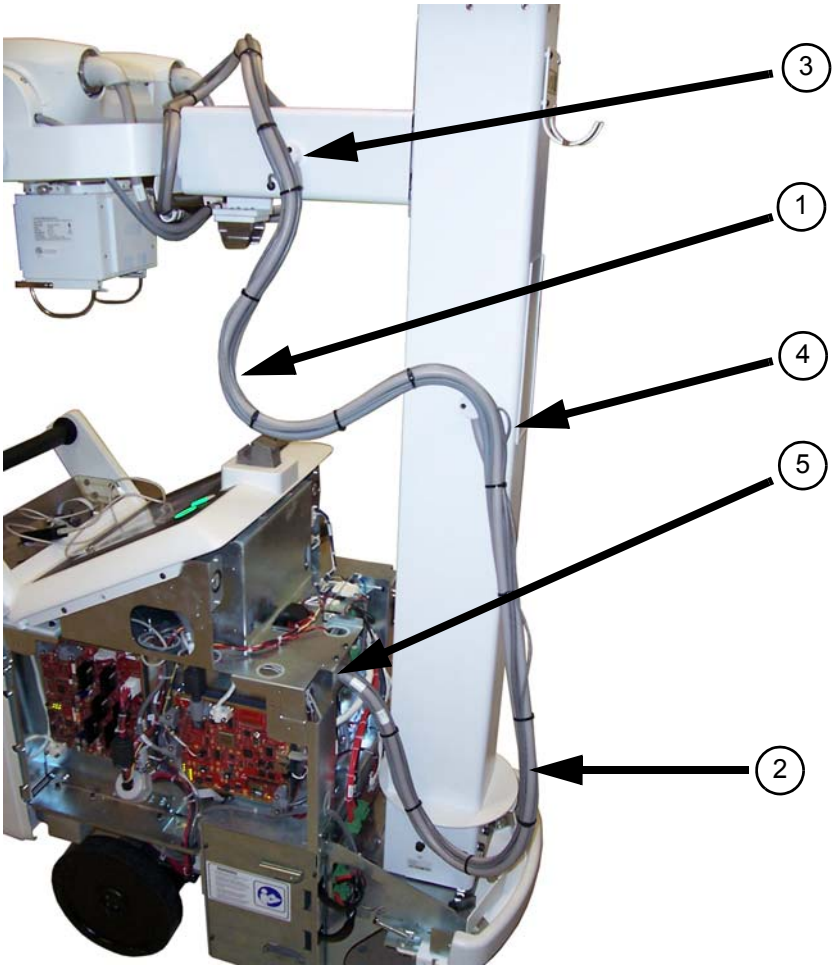
Item	Description
1	Cable clamps
2	Cable ties
3	Horizontal arm
4	Vertical column

Figure 8-19 Cable clamps and ties

6. Use a HV spanner wrench to loosen and remove the HV cable tightening ring(s) at the X-ray tube. Pull the cable(s) out of the tube.
7. Lay the old cable down next to the new cable and transfer the cable clamp and cable tie position marks over to the new cable. If both cables are being replaced, be sure to pair up anode cables and cathode cables.
8. Remove the ferrites (see Figure 8-17, Item 3) from the old HV cables and install them in the same locations on the new HV cables.

Note: Some of the original systems had HV cables that are approximately 250mm (10 inches) shorter than the replacement HV cables. Distribute the additional cable length as follows (see Figure 8-20):

- Add 75mm (3 inches) in Loop 1 (Item 1) between the two plastic cable clamps on the horizontal arm (Item 3) and vertical column (Item 4)
- Add 175mm (7 inches) in Loop 2 (Item 2) between the plastic clamp on the vertical column (Item 4) and the clamp near the Djinn HV tank (Item 5)



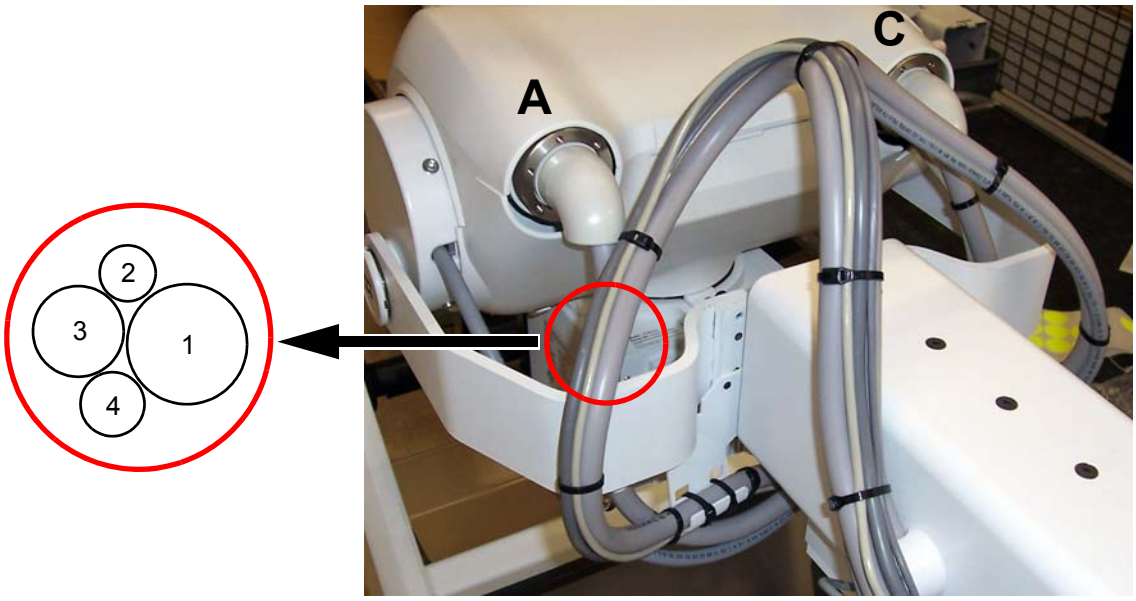
Item	Description
1	Loop 1 - Add 75mm (3 inches)
2	Loop 2 - Add 175mm (7 inches)
3	Cable clamp on the horizontal arm
4	Cable clamp on the vertical column
5	Cable clamp near Djinn HV Tank

Figure 8-20 HV cables

Note: HV cables must be lubricated with silicone **grease** (GE P/N 46-125224P3 or equivalent) before insertion into the **X-ray tube HV wells**.

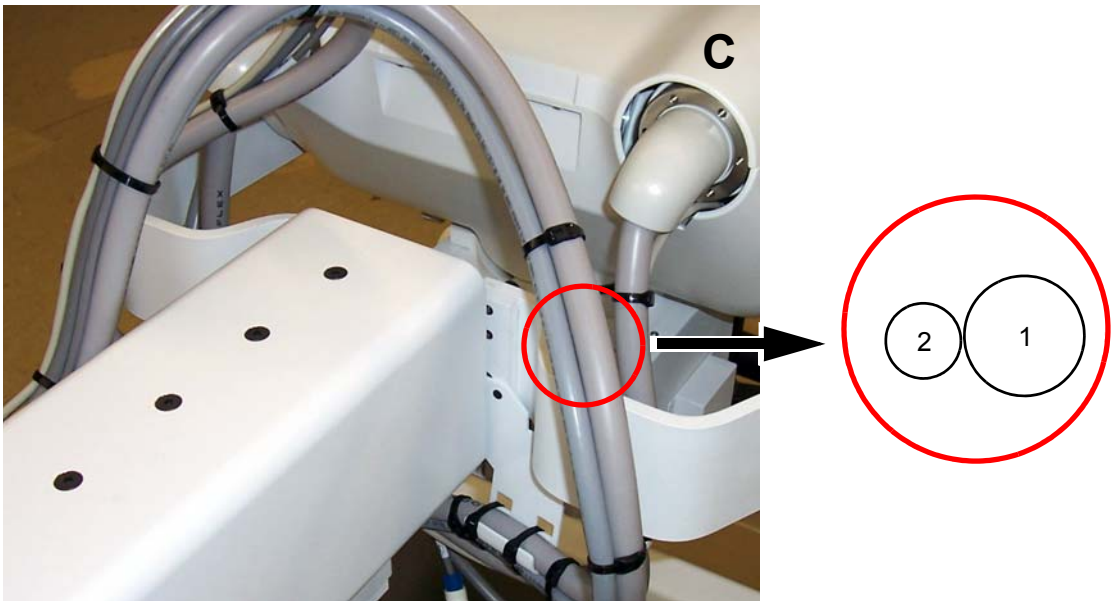
9. Insert the new cable(s) into the X-ray tube HV well(s). Make sure that the cable marking (Tube Anode or Tube Cathode) matches up with the X-ray tube marking (Anode or Cathode).
   Route the cable(s) along the vertical column and horizontal arm, installing cable clamps and cable ties at the marked positions.
   If the new HV cables are longer than the old cables, be sure to distribute the extra length as shown in Figure 8-20.

10. At the rear of the X-ray tube, route the cables and apply cable ties as shown in Figure 8-21, Figure 8-22 and Figure 8-23.



Item	Description
1	Cathode high voltage cable
2	Wireless detector cable(digital systems only)
3	Collimator cable
4	DAP cable(standard on Optima XR220amx, optional on Optima XR200amx)

Figure 8-21 Cable identification at Anode side of X-ray tube



Item	Description
1	Anode high voltage cable
2	Stator cable

Figure 8-22 Cable identification at Cathode side of X-ray tube

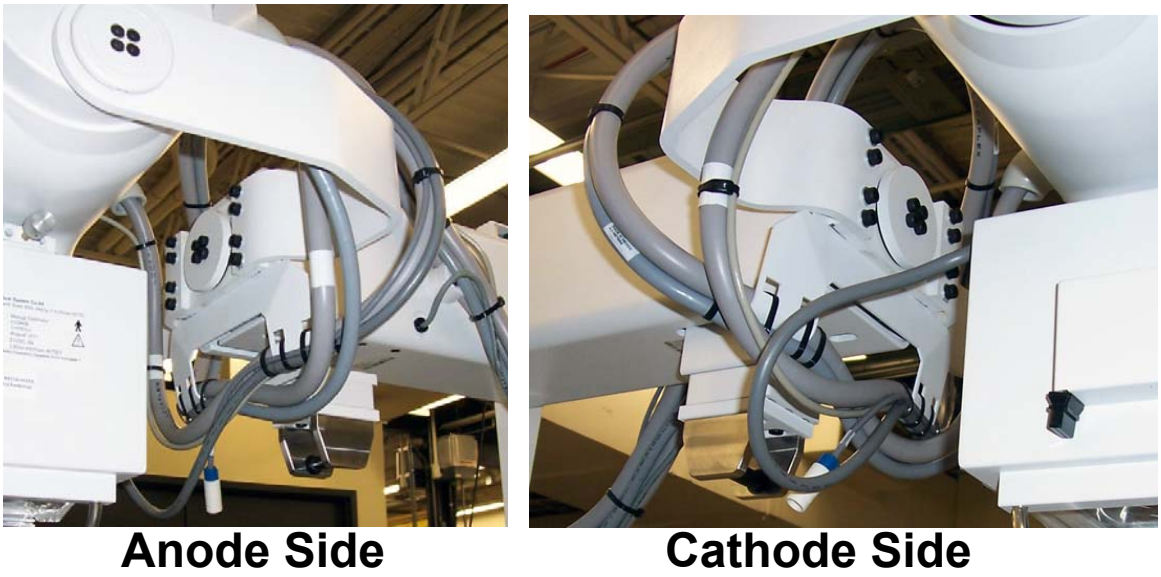


Figure 8-23 Cable routing at rear of X-ray tube

Note: HV cables must be lubricated with silicone **oil** (GE P/N LNR8733) before insertion into the **tank HV wells**. See Figure 8-24.

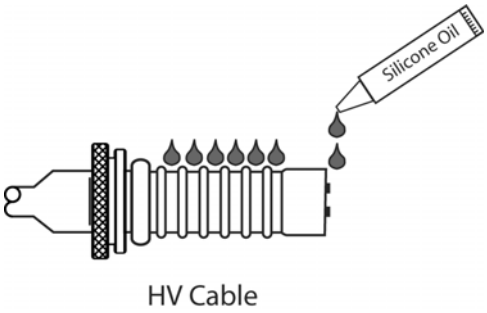
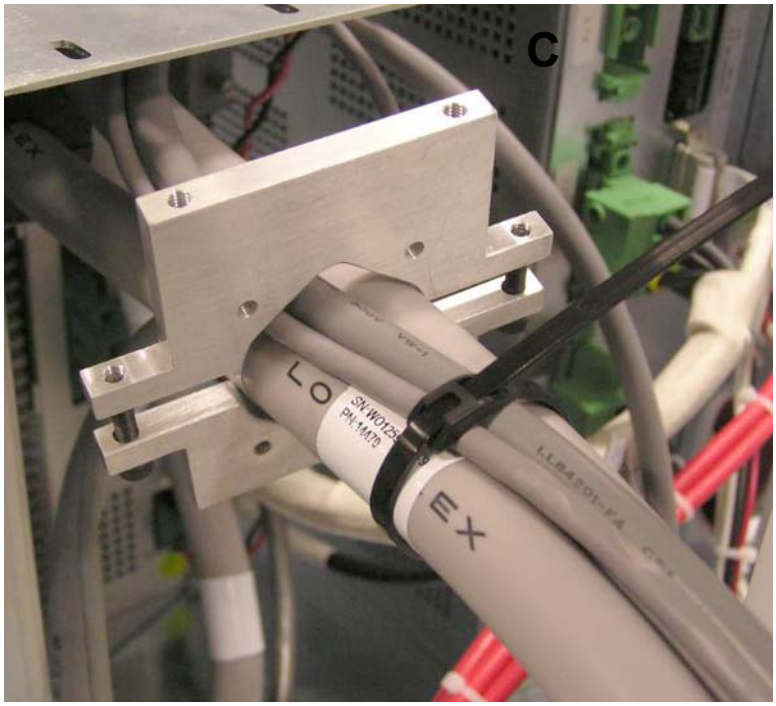
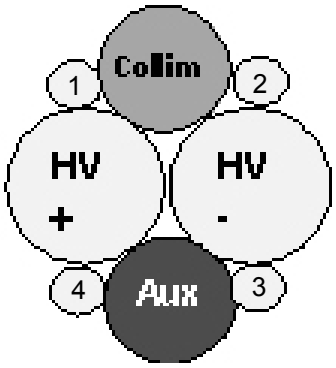


Figure 8-24 Lubricate HV cables

11. Insert the new cable(s) into the Djinn HV tank well(s). Make sure that the cable marking (Djinn Anode or Djinn Cathode) matches up with the HV tank marking (Anode or Cathode). See Figure 8-17. Tighten the HV cable tightening ring(s), then tighten the set screw(s) in the ring(s) (see Figure 8-18).
12. Arrange the cable bundle as shown in Figure 8-25, use a cable tie to maintain cable positions.
13. Install the clamp onto the cable bundle. DO NOT TIGHTEN THE CLAMP YET.
14. Mount the clamp to the Thorax chassis. Slide the clamp to the rear of the mounting screw slots.
15. Tighten the clamp around the cable bundle, ensuring that the cables are not pinched by the clamp.





Item	Description
1	DAP cable (optional for Optima XR200amx systems)
2	Wireless cable (only valid for Optima XR220amx systems)
3	Vertical brake cable
4	Horizontal arm lock cable

Figure 8-25 Correct cable bundle arrangement

16. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
17. Install the system covers.

8.2.2.4 Finalization

Perform the following HHS checks:

- mAs accuracy - see 7.1.4.3 Testing mAs accuracy on page 124

8.2.3 "Super cable" 5557068 cable replacement

Some early production units were shipped with cable assembly 5557068 (see Figure 8-26). This cable assembly consisted of a bundle of the following individual cables:

- Locust to LVLE2
- Locust to Caterpillar
- Locust to Park Latch

The original cable (5557068) is not available as a replacement part and must be replaced with the individual cables as identified above.

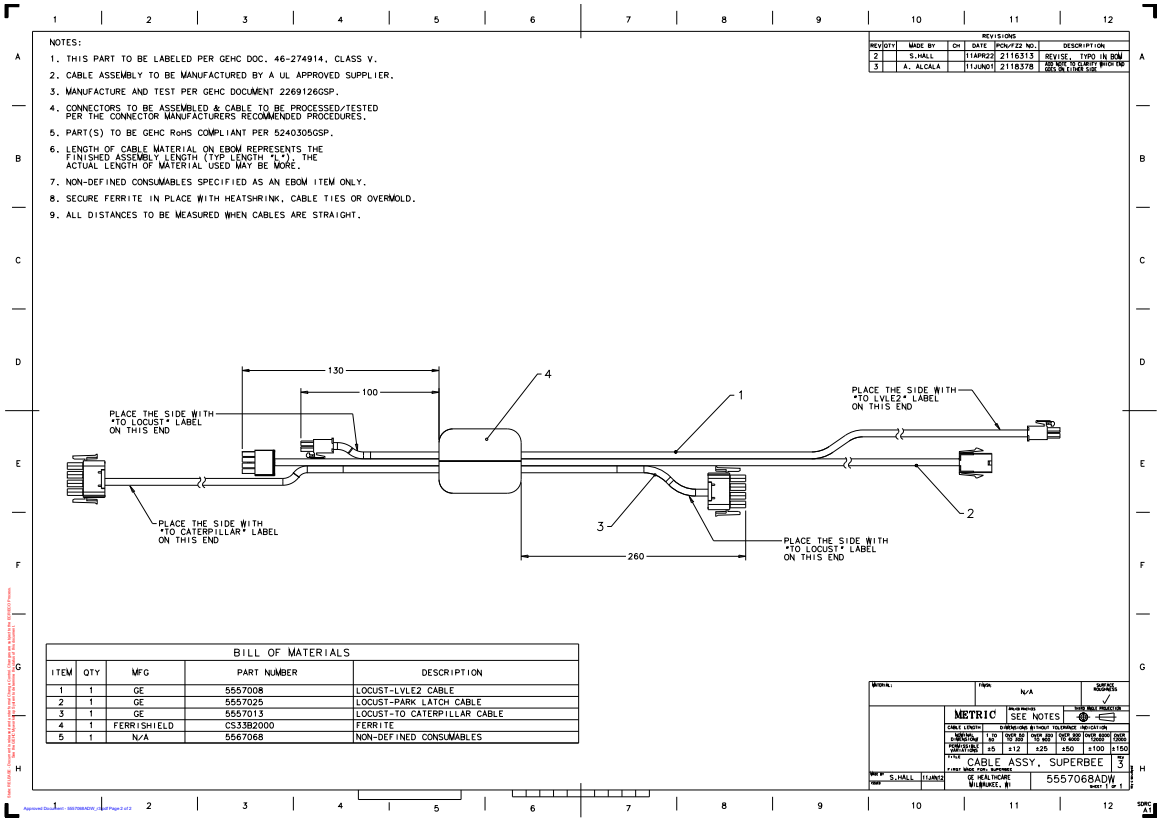

NOTES:
1. THIS PART TO BE LABELED PER GEHC DOC. 46-274914, CLASS V.
2. CABLE ASSEMBLY TO BE MANUFACTURED BY A UL APPROVED SUPPLIER.
3. MANUFACTURE AND TEST PER GEHC DOCUMENT 2269126GSP.
4. CONNECTORS TO BE ASSEMBLED & CABLE TO BE PROCESSED/TESTED PER THE CONNECTOR MANUFACTURERS RECOMMENDED PROCEDURES.
5. PART(S) TO BE GEHC RoHS COMPLIANT PER 5240305GSP.
6. LENGTH OF CABLE MATERIAL ON EBOM REPRESENTS THE FINISHED ASSEMBLY LENGTH (TYP LENGTH "L"). THE ACTUAL LENGTH OF MATERIAL USED MAY BE MORE.
7. NON-DEFINED CONSUMABLES SPECIFIED AS AN EBOM ITEM ONLY.
8. SECURE FERRITE IN PLACE WITH HEATSHRINK, CABLE TIES OR OVERMOLD.
9. ALL DISTANCES TO BE MEASURED WHEN CABLES ARE STRAIGHT.
REVISIONS
130
100
260
PLACE THE SIDE WITH "TO LOCUST" LABEL ON THIS END
PLACE THE SIDE WITH "TO CATERPILLAR" LABEL ON THIS END
PLACE THE SIDE WITH "TO LVLE2" LABEL ON THIS END
PLACE THE SIDE WITH "TO LOCUST" LABEL ON THIS END
BILL OF MATERIALS
ITEM QTY MFG PART NUMBER DESCRIPTION
1 1 GE 5557008 LOCUST-LVLE2 CABLE
2 1 GE 5557025 LOCUST-PARK LATCH CABLE
3 1 GE 5557013 LOCUST-TO CATERPILLAR CABLE
4 1 FERRISHIELD CS33B2000 FERRITE
5 1 N/A 5567068 NON-DEFINED CONSUMABLES
METRIC
SEE NOTES
CABLE ASSY, SUPERBEE
5557068ADW

Figure 8-26 "Super cable" 5550768

8.2.3.1 Personnel requirements

Required persons: 1

Timing (min): 120

8.2.3.2 Preliminary requirements

8.2.3.2.1 Tools and test equipment

- Standard tool kit

8.2.3.2.2 Consumables

- Cable ties

8.2.3.2.3 Replacement parts

Item: Cable assemblies (need all three cables to replace 'Super cable' 5557068):

- Locust to LVLE2
- Locust to Caterpillar
- Locust to Park Latch

Quantity: 1 each

8.2.3.2.4 Safety

- None

8.2.3.2.5 Required conditions

- Remove the side covers, top cover and the rear bin. See 8.1.5 Rear bin removal on page 157.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.2.3.3 Procedure

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

See Section 8.2.1 General cable replacement on page 162 for generic cable replacement steps.

1. Remove the 7 fasteners (4 nuts, 3 cap screws) and heat shield from the right side of the unit. See Figure 8-27.

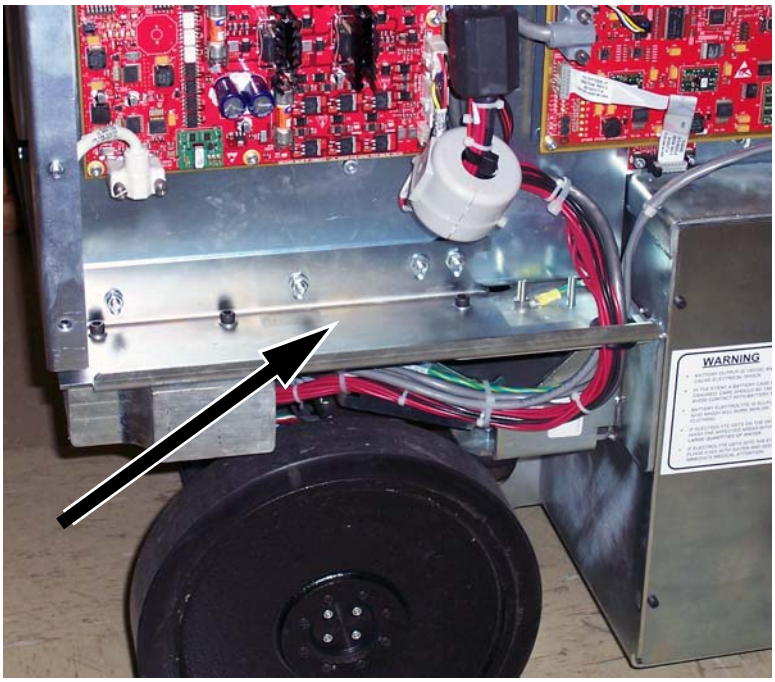


Figure 8-27 Heat shield

2. Remove the existing 'super cable'.
3. Install the three replacement cables (Locust to LVLE2, Locust to Caterpillar, Locust to Park Latch).
4. Install cable ties on the new cables.
5. Install the heat shield.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the covers.

8.2.3.4 Finalization

Perform the following tests:

- Cable Assy - Locust to LVLE2 - see Table 8-1
- Cable Assy - Locust to Caterpillar - see Table 8-1
- Cable Assy - Locust to Park Latch - see Table 8-1

8.2.4 Spyder to Board Data Module Cable Replacement

This is a new replacement cable. Part number 5557049-2 replaces the original cable part number 5557049. The new cable is shielded and requires a ground cable connection. The original cable did not have these features. The original cable is no longer orderable as the new part is a direct replacement in all cases.

8.2.4.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.2.4.2 Preliminary requirements

8.2.4.2.1 Tools and test equipment

- Standard tool kit

8.2.4.2.2 Consumables

- None

8.2.4.2.3 Replacement parts

Item: Shielded cable

Quantity: 1 each

8.2.4.2.4 Safety

- None

8.2.4.2.5 Required conditions

- Remove the right side cover. See 8.1.1 Side cover removal on page 150.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

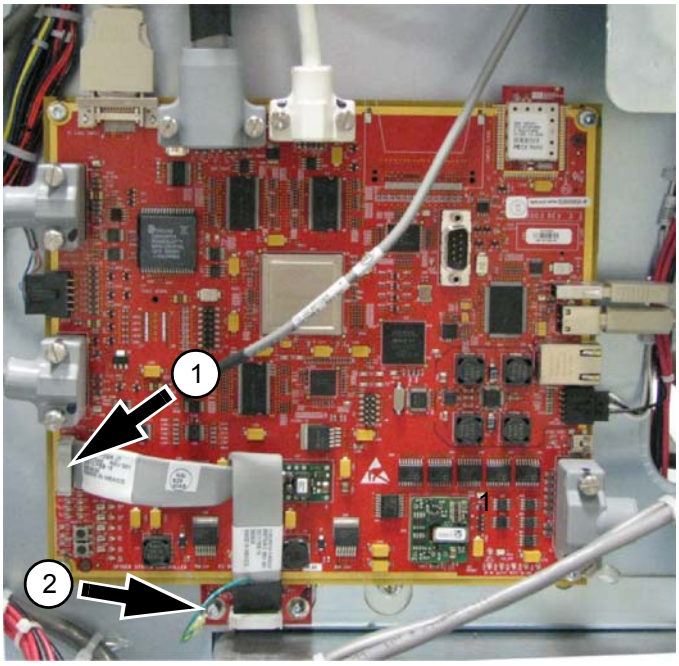
8.2.4.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Perform LOTO on the system.
2. Disconnect the cable from the Spyder board J7. See Figure 8-28, Item 1.



Item	Description
1	Spyder J7 connector
2	BDM fastener

Figure 8-28 Shielded Spyder to BDM cable

3. Disconnect the cable from the BDM module.
4. Remove the fastener on the left side of the BDM module. See Figure 8-28, Item 2.

Note: There are washers on the front and back of the BDM module. These back side washers MUST be used to properly mount the BDM.

5. Install the fastener previously removed and tighten securely.
   a. Orient the cable ground as shown in Figure 8-28 to prevent accidental shorting.
   b. Ensure washers are properly installed both front and rear.
6. Connect the grounded cable end to the BDM module.
7. Connect the BDM cable to the Spyder J7 connector.
8. Remove LOTO.

9. Install system covers.
10. Restore system power.

8.2.4.4 Finalization

- None required.

Note: If the system reports a `BDM Mismatch error detected` with 2 selections, RESTORE and CANCEL, make sure you select CANCEL to have the Spyder upload the correct contents to the Board Data Module. Failure to do so will result in erratic or failed system functionality. Recovery requires a complete firmware download and system calibrations.

Section 8.3 Software Load From Cold

See Chapter 3 System data and software on page 43.

Section 8.4 Base assembly

8.4.1 Drive wheel

8.4.1.1 Personnel requirements

Required persons: 1 or 2

Timing (min): 30

8.4.1.2 Preliminary requirements

8.4.1.2.1 Tools and test equipment

- Standard tool kit
- 3 - 2 x 4 inch wood blocks (or equivalent)
- 1 - 3 ft.to 4 ft. (1.0 to 1.2 m) wood lever (or equivalent)
  (Lever to be construction grade or better with no splits, bowing, and free from knots)

8.4.1.2.2 Consumables

- Loctite 242 (GE part# 46-170686P2) or equivalent

8.4.1.2.3 Replacement parts

Item: Drive wheel

Quantity: 1

8.4.1.2.4 Safety

- PPE - Gloves
- PPE - Kneeling pad

WARNING

TIPPING

TIPPING HAZARD
THE POTENTIAL FOR SERIOUS INJURY OR DEATH EXISTS. ENSURE WORK AREA IS FREE AND CLEAR OF ANY PERSONS OR OBJECTS WITHIN A 3 METER RANGE OF THE SYSTEM.

8.4.1.2.5 Required conditions

- Remove the side cover for the wheel that requires replacement. See 8.1.1 Side cover removal.
- Remove the front cover for the wheel that requires replacement. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Tube arm must be in the latched position.

CAUTION

Tipping

TIPPING HAZARD
FAILURE TO LATCH THE TUBE ARM WILL RESULT IN A CHANGE OF THE CENTER OF GRAVITY OF THE SYSTEM. THIS CAN RESULT IN UNCONTROLLED LIFT AND TIPPING OF THE SYSTEM.

8.4.1.3 Procedure

1. A fulcrum and lever will be used to create a controlled lift of the system. See Figure 8-29 for the dimensional representation.

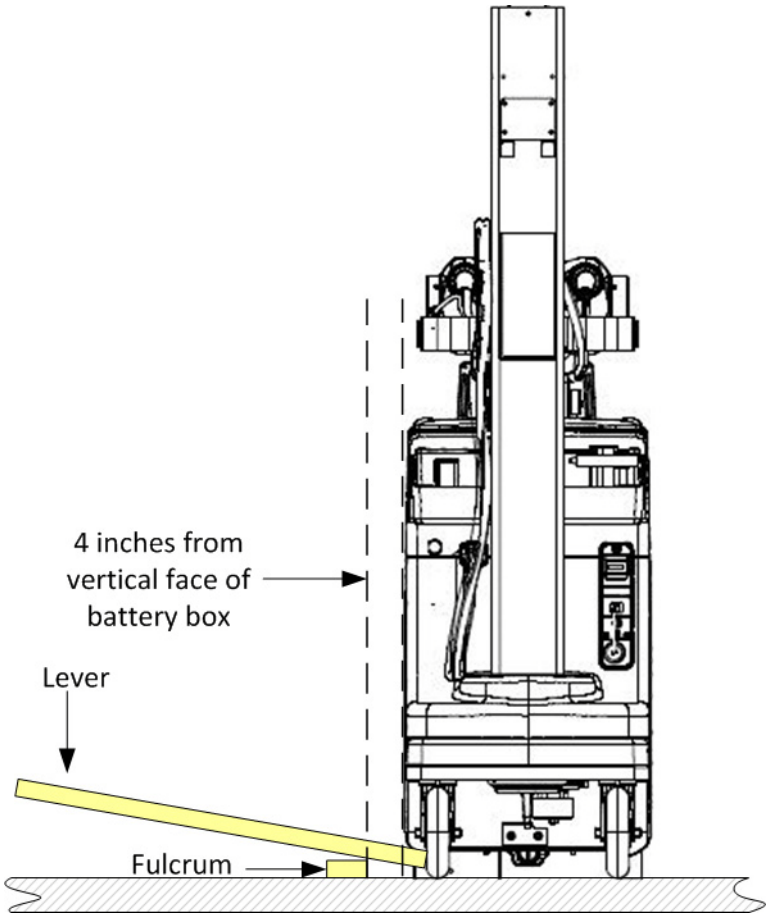


Figure 8-29 Lever and fulcrum locations

Note: **For system stability, the position of the support block is important. The support point must be close to the wheel to be replaced. See Figure 8-30.**

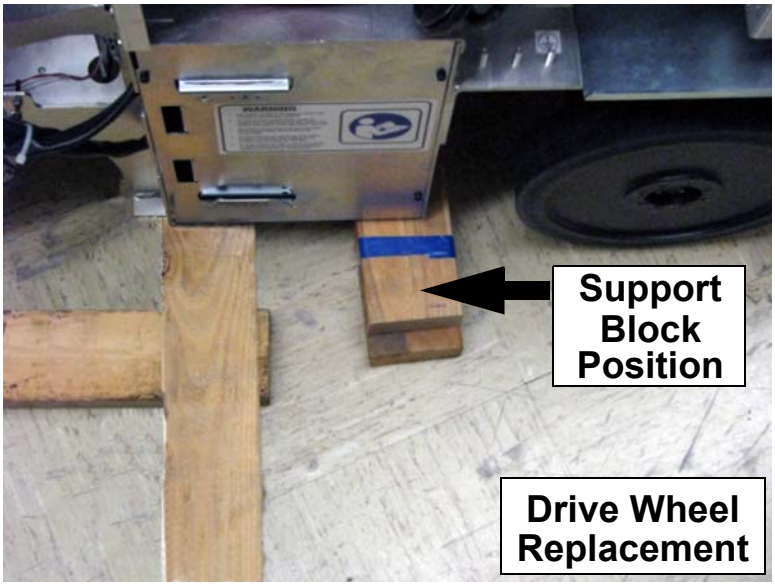


Figure 8-30 Drive wheel lift and support

The following steps are a generic representation of how to lift the system. Ensure the fulcrum, lever and support blocks are positioned correctly for the wheel being replaced.

2. Prepare the two 2 x 4 inch blocks. Secure them together using tape or screws. (Screws have been used in these examples.)

3. Position single 2 x 4 inch block approximately 4 inches from the vertical face of the battery box. Place lever approximately 2 inches under battery box, perpendicular to the vertical face of the battery box. Ensure the lever is fully supported on the fulcrum. See Figure 8-31.

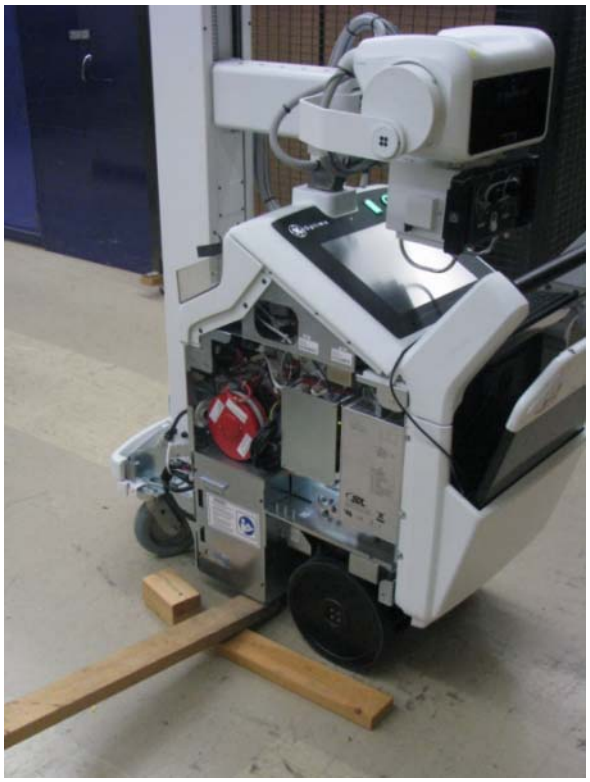


Figure 8-31 Lift and support unit

4. While applying downward pressure onto the end of the lever (see Figure 8-32 - left), position the two 2 x 4 support blocks under the other corner of the battery box (see Figure 8-32 - right).

Note: This example uses a one person standing position. This is simpler if two people are available.

Figure 8-32 Lift and support unit

5. Place aside the lever and fulcrum as needed for the remaining steps.

6. Remove the 8 mounting screws (Item 1) from the drive wheel (Item 2). See Figure 8-33.

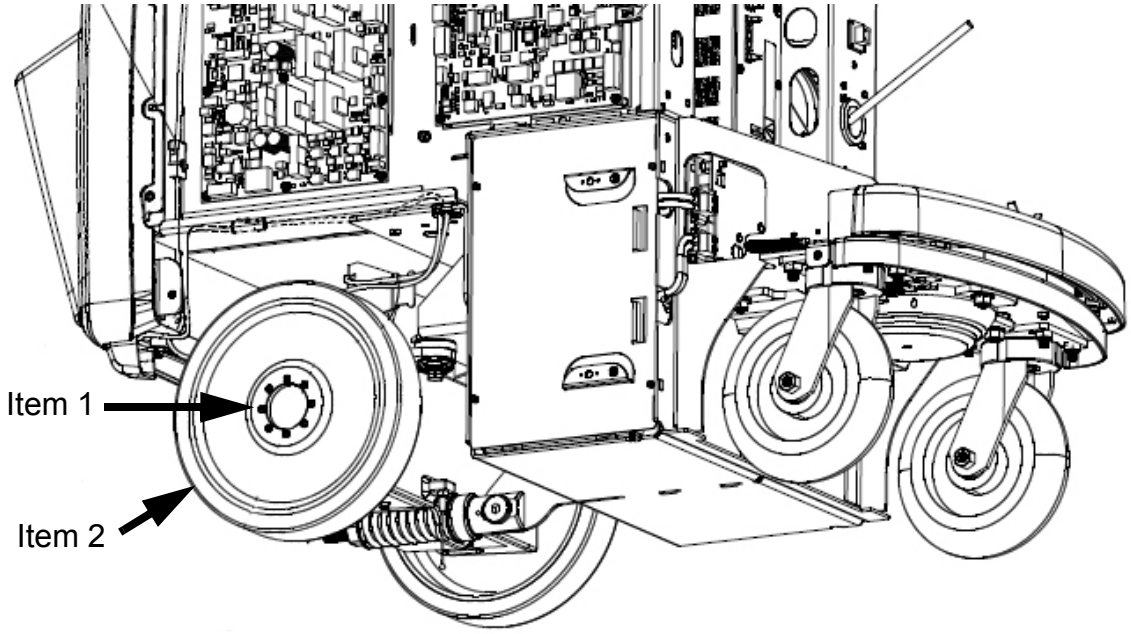


Figure 8-33 Drive wheel and mounting screws

7. Remove the drive wheel from the shaft.
8. Slide the new drive wheel onto the shaft.
9. Apply thread locker to the mounting screws. Install the mounting screws, finger-tight only. Make several passes, slightly tightening the screws in an alternating pattern until all the screws are fully seated. Torque to 3 N-m (2.2 lb-ft).
10. Lift the unit and remove the support blocks.
11. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
12. Install the covers.

8.4.1.4 Finalization

None

8.4.2 Battery packs

8.4.2.1 Personnel requirements

Required persons: 1

Timing (hours): 13

8.4.2.2 Preliminary requirements

8.4.2.2.1 Tools and test equipment

- Standard tool kit

8.4.2.2.2 Consumables

- None

8.4.2.2.3 Replacement parts

Item: Battery pack

Quantity: 1 to 4 as required

8.4.2.2.4 Safety

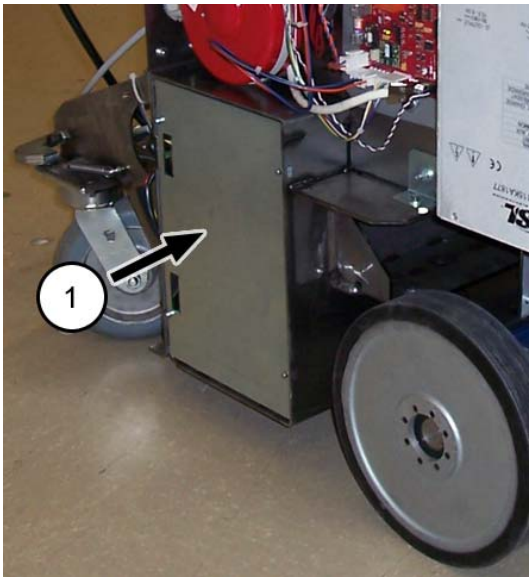
- Weight of an individual battery is approximately 22.7 kg (50 lbs).

8.4.2.2.5 Required conditions

- Remove the side covers. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Dedicated location for Battery Integration Procedure.

8.4.2.3 Procedure

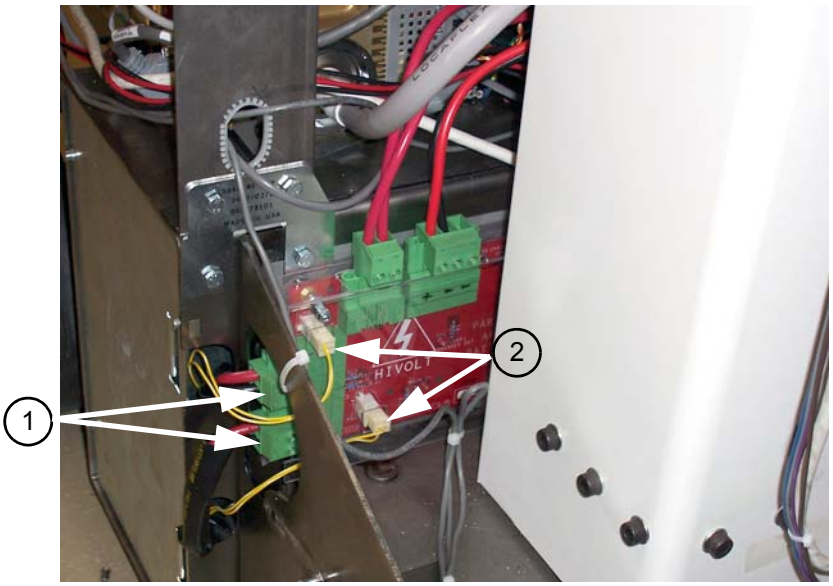
1. See Figure 8-34. Remove the battery compartment covers (Item 1) from both sides (4 screws on each cover).



Item	Description
1	Battery compartment cover (left side shown)

Figure 8-34 Battery compartment covers

2. See Figure 8-35. On the Cricket battery board, loosen the connector screws on the J1/J2 (left side) and the J3/J4 power connectors (Item 1 - right side), then unplug the cables.



Item	Description
1	Battery power connectors (J3, J4)
2	Battery sensing connectors (J13, J14)

Figure 8-35 Battery connectors (right side shown)

3. On the Cricket battery board, unplug the cables from the sensing connectors J11/J12 (left side) and J13/J14 (Item 2 - right side).
4. On each side, remove the top battery and then the bottom battery from the battery compartment.
5. Install the new batteries in the battery compartment.
6. Route the power and sensing cables through the cutouts in the chassis and plug them into the Cricket battery board (the upper battery cables go to the upper connectors on the Cricket battery board). Tighten down the connector screws for J1, J2, J3, J4 connectors.
7. Install the battery compartment covers. The tabs in the covers are intended to hold the batteries in the proper location and should be positioned towards the front of the unit. If the covers will not fit correctly, reposition the batteries to provide proper clearance.
   If the cover holes do not line up properly, rotate the cover 180 degrees (it is upside down).
8. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.

8.4.2.3.1 Battery Integration Procedure

1. Before you restore the system power you must configure the unit in “Safe Mode” charge.
2. Set jumper J17 on the Firefly board to the “Safe” position (pins 2 and 3).

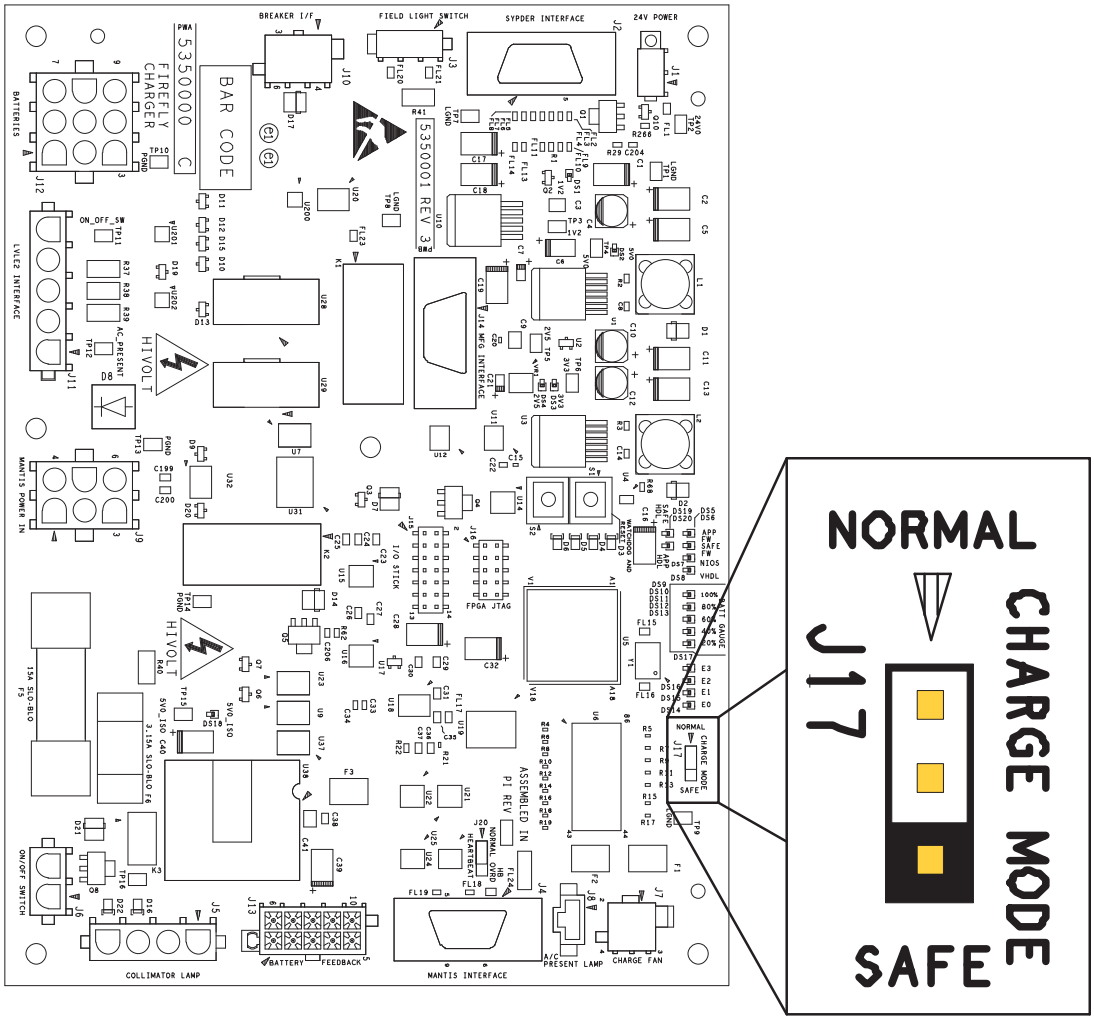


Figure 8-36 Normal Charging Mode Jumper Position

3. Install the system covers.
4. Ensure the circuit breaker is on.
5. Connect to an AC source.
6. Ensure the system is turned off.

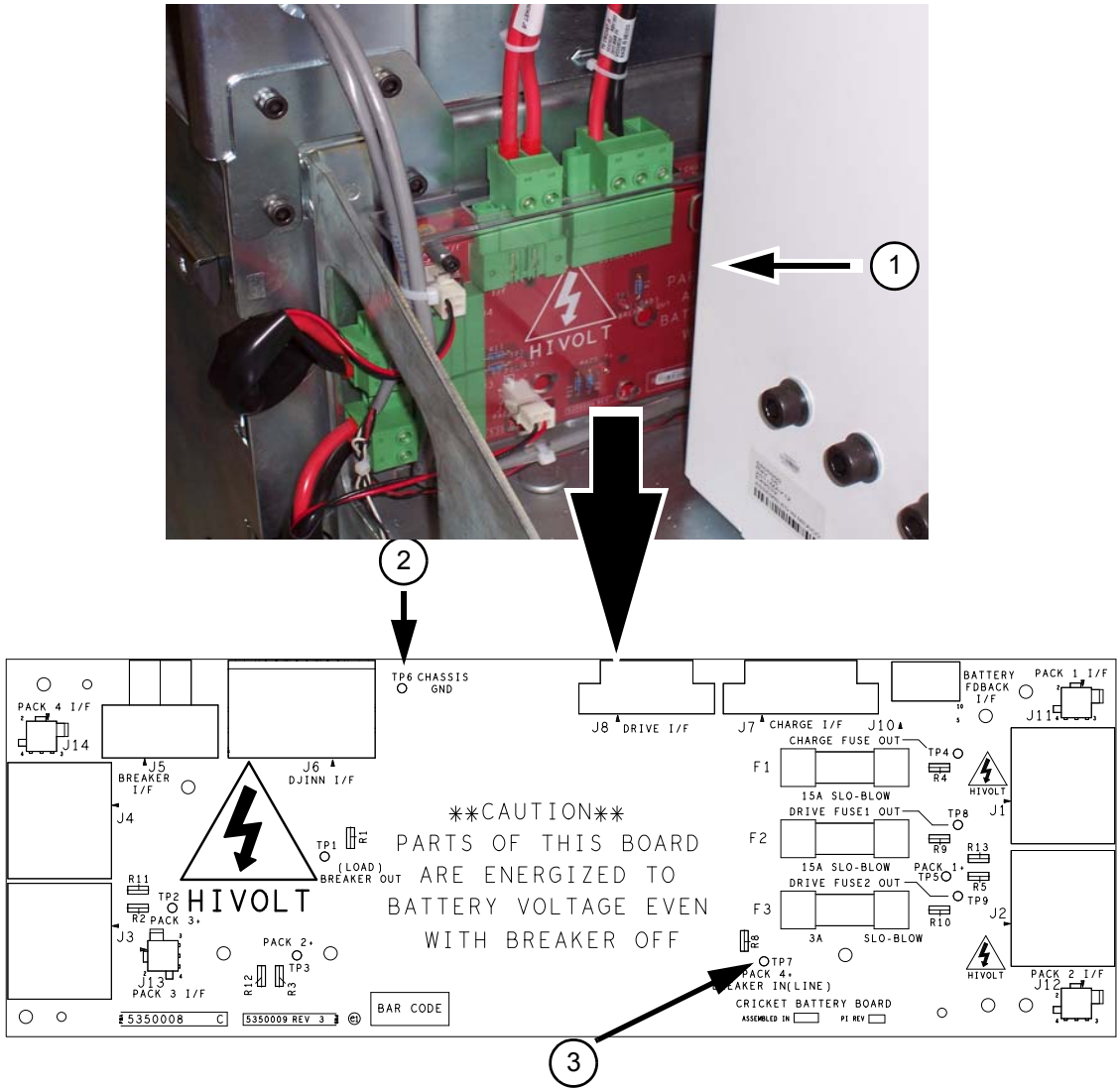
Note:. The Safe Mode is basically a trickle charger. If the system is on, the current draw on the batteries is greater than the charging current. This will result in a slow depletion of the remaining battery charge.

7. Allow unit to charge undisturbed for 8 hours (overnight is recommended).
8. Disconnect the AC plug from the AC source.
9. Perform LOTO.
10. Set jumper J17 on the Firefly board to the “Normal” position (pins 1 and 2).
11. Remove LOTO.
12. Ensure the circuit breaker is on.
13. Turn on the system.
14. Connect to an AC source.

15. Allow unit to charge undisturbed for approximately 5 hours.
    It is important for the system to charge at least 1 hour after the battery meter shows 100% charge. The synchronization of the battery meter to the actual battery state of charge occurs in the last phase of the charging cycle.

8.4.2.4 Finalization

1. Perform the following functional checks:
   - Charging - see Charging on page 35
   - Bus voltage level - The system batteries shall produce an open circuit voltage of 156VDC +/-5V when fully charged and less than 1 year old. Measure battery voltage on the Cricket Battery Board, at test points TP7 and TP6. See Figure 8-37.



Item	Description
1	Cricket battery board
2	Chassis ground test point - TP6
3	Battery voltage test point - TP7

Figure 8-37 Battery voltage measurement

2. Install the front covers.
3. Install the side covers.

8.4.3 Front bumper assembly or bumper switch

8.4.3.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.4.3.2 Preliminary requirements

8.4.3.2.1 Tools and test equipment

- Standard tool kit

8.4.3.2.2 Consumables

- None

8.4.3.2.3 Replacement parts

Item: Front bumper assembly
Quantity: 1
or
Item: Front bumper switch
Quantity: 1 or 2

8.4.3.2.4 Safety

- None

8.4.3.2.5 Required conditions

- Remove the side covers and front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.4.3.3 Procedure

8.4.3.3.1 Front bumper assembly

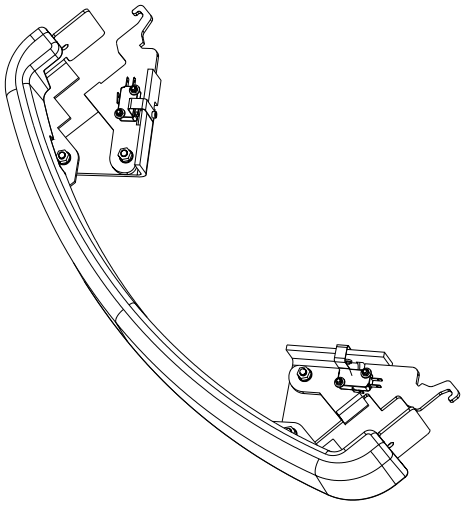
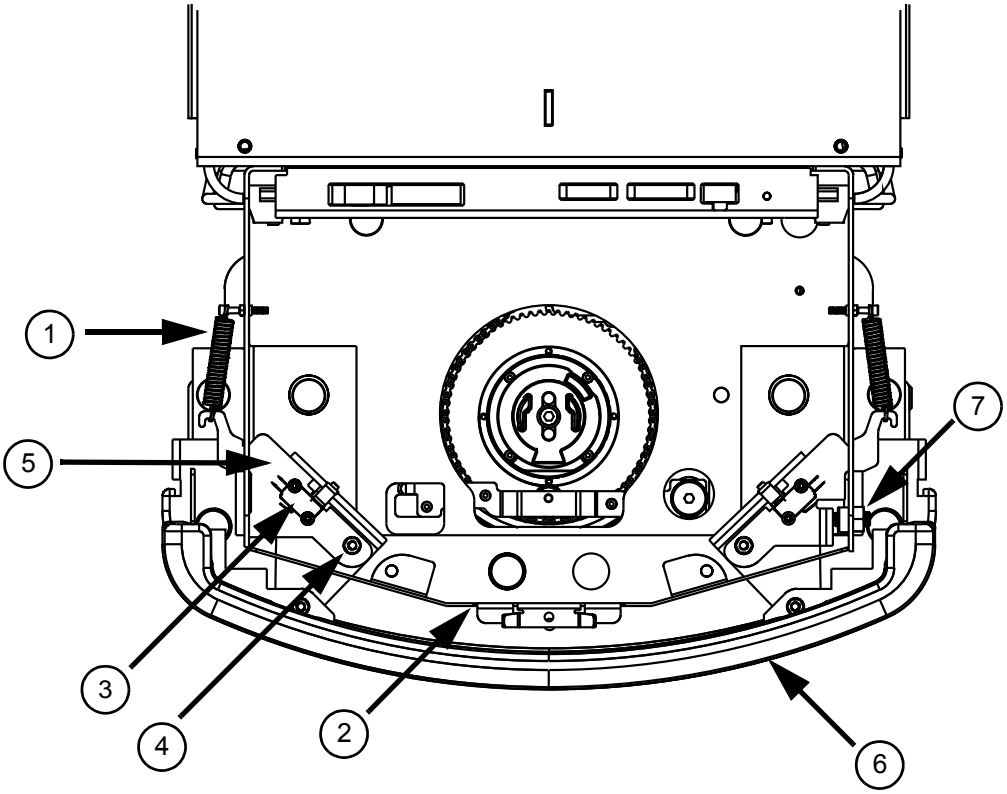


Figure 8-38 Front bumper assembly

1. See Figure 8-39. Using long-nose pliers, remove the extension springs (Item 1) from the cap screws on both sides.



Item	Description
1	Extension spring
2	Front bumper slot closure
3	Switch
4	Switch arm mounting nut
5	Switch arm
6	Front bumper
7	Adjustment screw

Figure 8-39 Front bumper assembly - top view

2. Remove the front bumper slot closure (Item 2). There are 2 mounting nuts that must be removed from underneath the chassis.
3. Remove the wires from the switches (Item 3 - both sides).
4. Remove the mounting nuts (Item 4 - both sides) from the switch arms (Item 5 - both sides).
5. Lift the switch arms off of the mounting studs and guide the ends of the switch arms through the slots in the chassis.
6. Slide the front bumper and attached parts (Item 6) out of the front of the unit.
7. On the new front bumper assembly, remove the mounting nuts (Item 4 - both sides) from the switch arms (Item 5 - both sides). Lift the switch arms off of the mounting studs.
8. Slide the new front bumper and attached parts (Item 6) in from the front of the unit.

9. Guide the ends of the switch arms (Item 5 - both sides) through the slots in the chassis, then place the switch arms onto the mounting studs and install the mounting nuts (Item 4 - both sides).
10. Connect the wires to the switches (Item 3 - both sides). The wires are connected to the common (COM) and normally open (NO) terminals on the switches.
11. Install the front bumper slot closure (Item 2). There are 2 mounting nuts that must be installed from underneath the chassis.
12. Using long-nose pliers, install the extension springs (Item 1 - both sides).
13. Adjust the adjustment screw (Item 7) to just remove any side-to-side play of the front bumper assembly.
14. Install the front covers and side covers.

8.4.3.3.2 Front bumper switch

1. See Figure 8-39. Remove the wires from the switch to be replaced (Item 3 - left and/or right).
2. Remove the mounting nuts (2) from the switch.
3. Replace the old switch with the new switch, install and tighten the mounting nuts.
4. Connect the wires to the switch. The wires are connected to the common (COM) and normally open (NO) terminals on the switches.
5. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
6. Install the front covers and side covers.

8.4.3.4 Finalization

Perform the following functional checks:

- Drive (all tests) - see Drive on page 35

8.4.4 Front caster

8.4.4.1 Personnel requirements

Required persons: 1 or 2

Timing (min): 30

8.4.4.2 Preliminary requirements

8.4.4.2.1 Tools and test equipment

- Standard tool kit
- 3 - 2 x 4 inch wood blocks (or equivalent)
- 1 - 3 ft. to 4 ft. (1.0 to 1.2 m) wood lever (or equivalent)
  (Lever to be construction grade or better with no splits, bowing, and free from knots)

8.4.4.2.2 Consumables

- None

8.4.4.2.3 Replacement parts

Item: Front caster

Quantity: 1

8.4.4.2.4 Safety

- PPE - Gloves
- PPE - Kneeling pad

WARNING

TIPPING

TIPPING HAZARD
THE POTENTIAL FOR SERIOUS INJURY OR DEATH EXISTS. ENSURE WORK AREA IS FREE AND CLEAR OF ANY PERSONS OR OBJECTS WITHIN A 3 METER RANGE OF THE SYSTEM.

8.4.4.2.5 Required conditions

- Remove the side cover for the caster that requires replacement. See 8.1.1 Side cover removal.
- Remove the front cover for the caster that requires replacement. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Tube arm must be in the latched position.

CAUTION

Tipping

TIPPING HAZARD
FAILURE TO LATCH THE TUBE ARM WILL RESULT IN A CHANGE OF THE CENTER OF GRAVITY OF THE SYSTEM. THIS CAN RESULT IN UNCONTROLLED LIFT AND TIPPING OF THE SYSTEM.

8.4.4.3 Procedure

1. A fulcrum and lever will be used to create a controlled lift of the system. See Figure 8-40 for the dimensional representation.

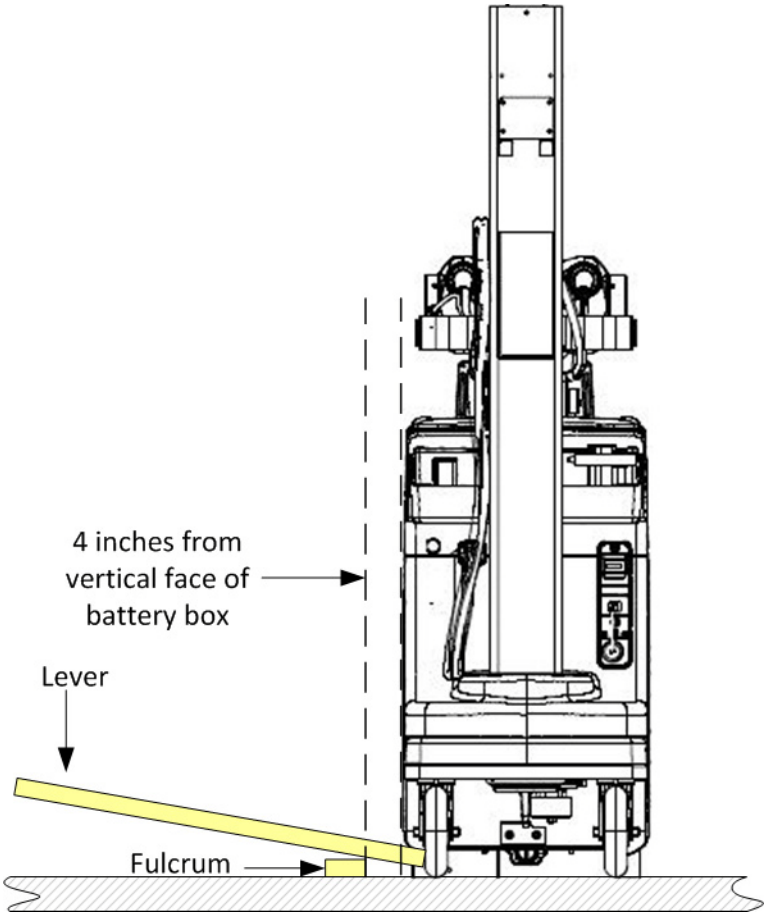


Figure 8-40 Lever and fulcrum locations

Note: **For system stability, the position of the support block is important. The support point must be close to the caster to be replaced. See** Figure 8-41**.**

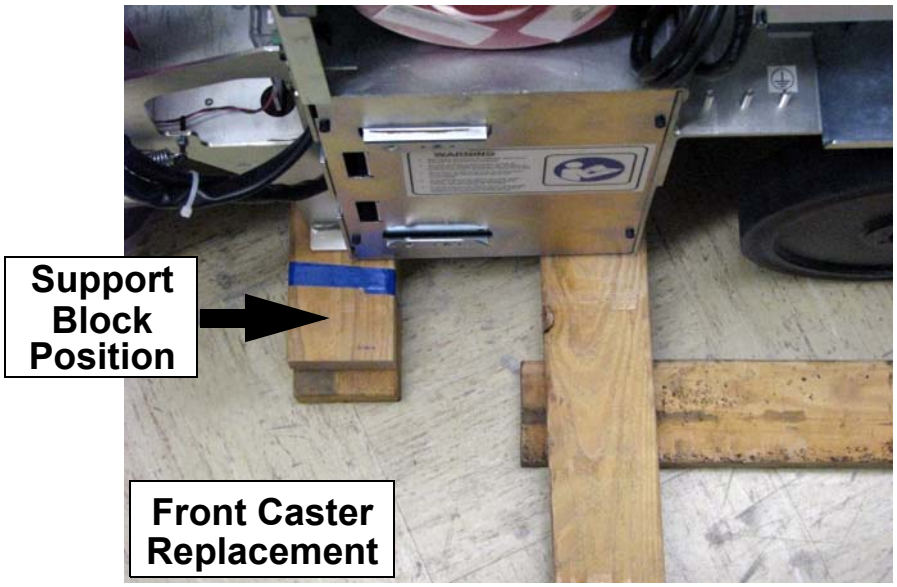


Figure 8-41 Front caster lift and support

The following steps are a generic representation of how to lift the system. Ensure the fulcrum, lever and support blocks are positioned correctly for the caster being replaced.

2. Prepare the two 2 x 4 inch blocks. Secure them together using tape or screws. (Screws have been used in these examples.)

3. Position single 2 x 4 inch block approximately 4 inches from the vertical face of the battery box. Place lever approximately 2 inches under battery box, perpendicular to the vertical face of the battery box. Ensure the lever is fully supported on the fulcrum. See Figure 8-42.

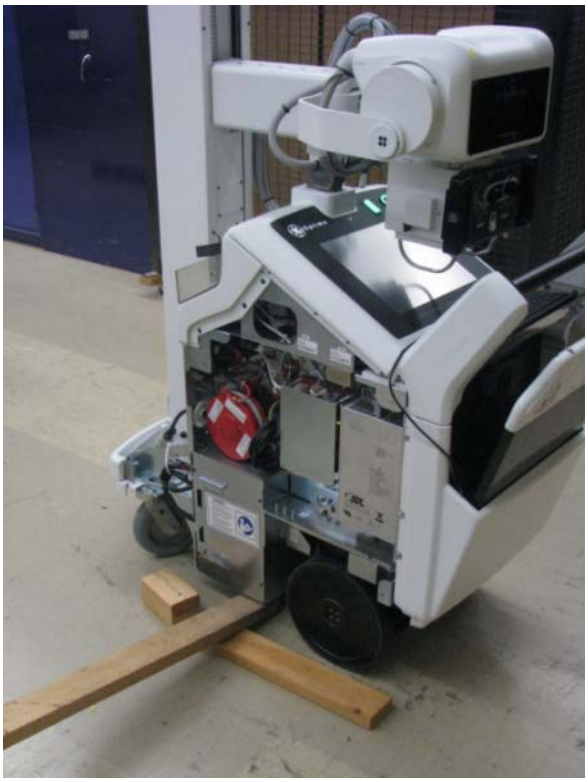


Figure 8-42 Lift and support unit

4. While applying downward pressure onto the end of the lever (see Figure 8-43 - left), position the two 2 x 4 support blocks under the other corner of the battery box (see Figure 8-43 - right).

Note: This example uses a one person standing position. This is simpler if two people are available.

Figure 8-43 Lift and support unit

5. Place aside the lever and fulcrum as needed for the remaining steps.

6. See Figure 8-44. At the top of the caster (Item 1), remove the 4 mounting nuts from the studs.

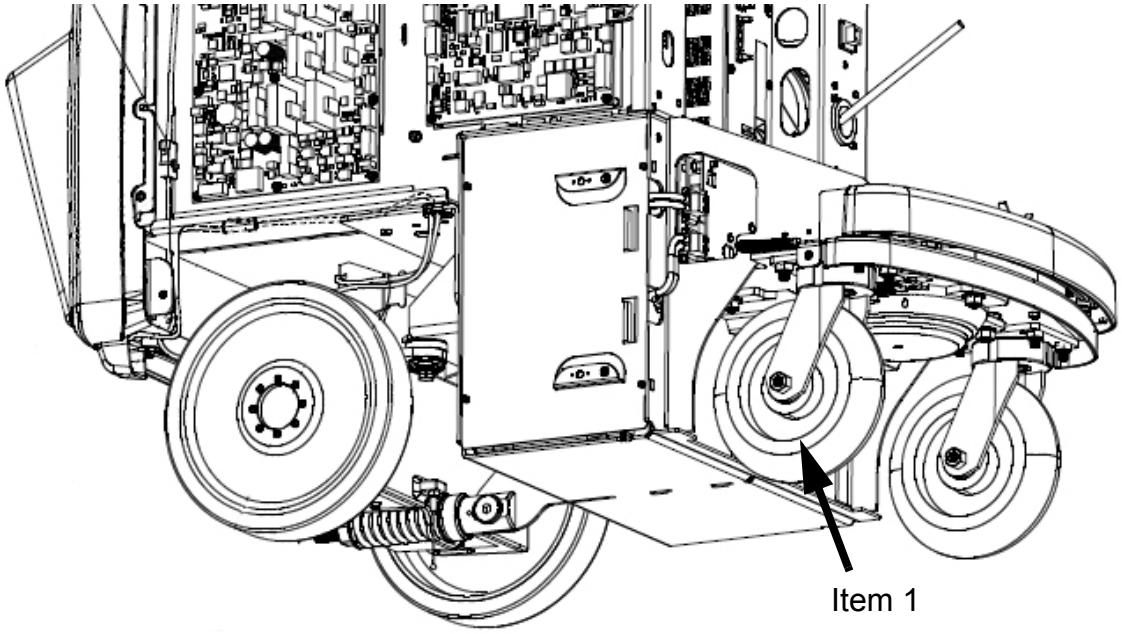


Figure 8-44 Caster location

7. Slightly tip the caster, and remove it from the unit.
8. Install the new caster onto the studs.
9. Install and tighten the mounting nuts.
10. Lift the unit and remove the support blocks.
11. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
12. Install the covers.

8.4.4.4 Finalization

None

8.4.5 Spring applied brake (column rotational brake)

8.4.5.1 Personnel requirements

Required persons: 1

Timing (min): 45

8.4.5.2 Preliminary requirements

8.4.5.2.1 Tools and test equipment

- Standard tool kit

8.4.5.2.2 Consumables

- Cable ties

8.4.5.2.3 Replacement parts

Item: Spring applied brake

Quantity: 1

8.4.5.2.4 Safety

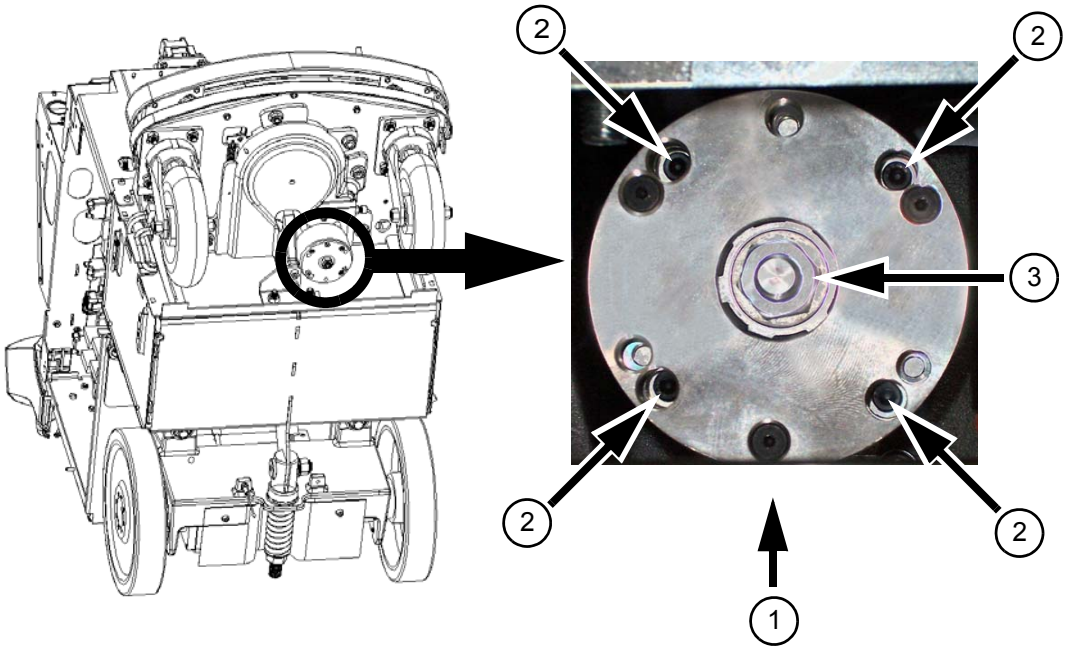
- None

8.4.5.2.5 Required conditions

- Remove the left side cover and left front cover. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.4.5.3 Procedure

1. See Figure 8-45. Use a 3mm allen wrench to remove the four mounting screws (Item 2) from the bottom of the column rotation lock assembly (Item 1).



Item	Description
1	Column rotation lock assembly
2	Mounting screws (4 used)
3	Nut

Figure 8-45 Column rotation lock assembly (bottom view)

2. Remove the nut (Item 3) from the lock assembly. The assembly should easily come off of the tapered shaft, but could require gentle prying with a screwdriver to release it.
3. Unplug the lock assembly cable connector and cut any cable ties as required to remove the cable. The connector is located on top of the base assembly, behind the vertical column. Rotate the column to a position that allows maximum access to the connector.
4. Remove the old lock assembly from the unit.
5. Route the cable from the new lock assembly up through the access hole in the base and plug it into the connector. Install new cable ties to replace those removed in Step 3 above. Verify that the cable routing prevents the column from rubbing against the cable during rotation.
6. Place the lock assembly on the shaft and install the nut (finger-tighten only).
7. Position the lock assembly so that the cable is oriented towards the rear of the unit.
8. Install and tighten the four mounting screws (Item 2) 1/4 turn past snug. No need to over-tighten.
9. Tighten the nut (Item 3). Torque to 25N-m (18.5lb-ft).
10. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
11. Install the front cover and side cover.

8.4.5.4 Finalization

Perform the following functional checks:

- Tube column and arm (locks & latches) - see Tube column and arm on page 35

8.4.6 Column support assembly

8.4.6.1 Personnel requirements

Required persons: 2

Timing (min): 210

8.4.6.2 Preliminary requirements

8.4.6.2.1 Tools and test equipment

- Standard tool kit

8.4.6.2.2 Consumables

- Cable ties
- HV Tube Grease (GE part# 46-125224P3, Silicon Grease) or equivalent
- Loctite 242 (GE part# 46-170686P2) or equivalent

8.4.6.2.3 Replacement parts

Item: Column support assembly

Quantity: 1

8.4.6.2.4 Safety

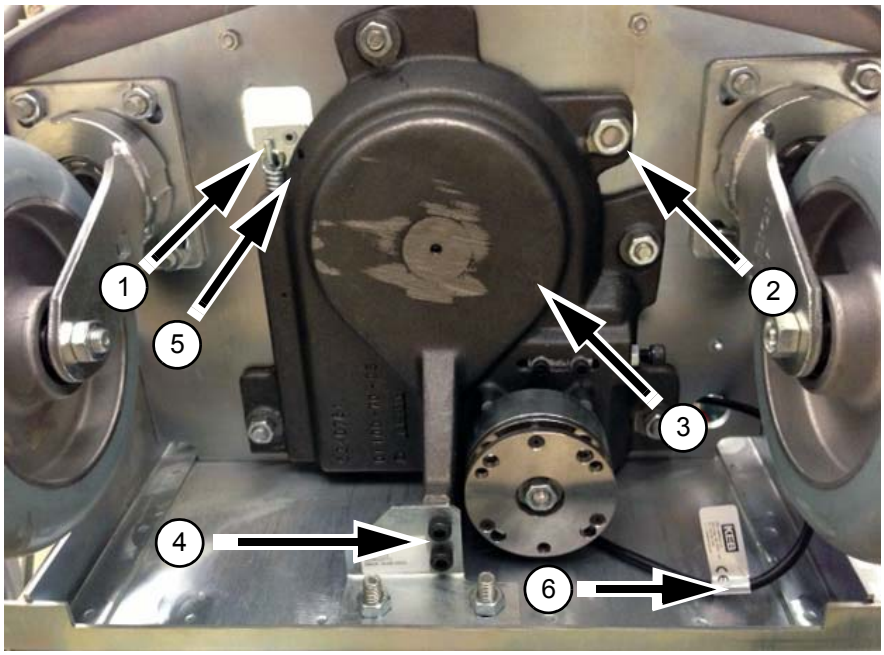
- The column vertical lock must be engaged before any weight (i.e. horizontal arm, X-ray tube, collimator) is removed from the vertical carriage.

8.4.6.2.5 Required conditions

- Remove the side covers and front covers. See 8.1.3 Front cover removal on page 152.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Remove the column skirt covers. See 8.1.6 Column skirt cover removal on page 160.
- Lock the vertical carriage. See 8.6.1 Engaging vertical lock on page 315.
- Remove the collimator. See 8.6.9.1 Collimator replacement on page 358.
- Remove the X-ray tube. See 8.6.8 Toshiba X-ray tube on page 353.
- Remove the horizontal arm. See 8.6.3 Horizontal arm assembly on page 327.
- Remove the Column. See 8.6.2 Column on page 318.

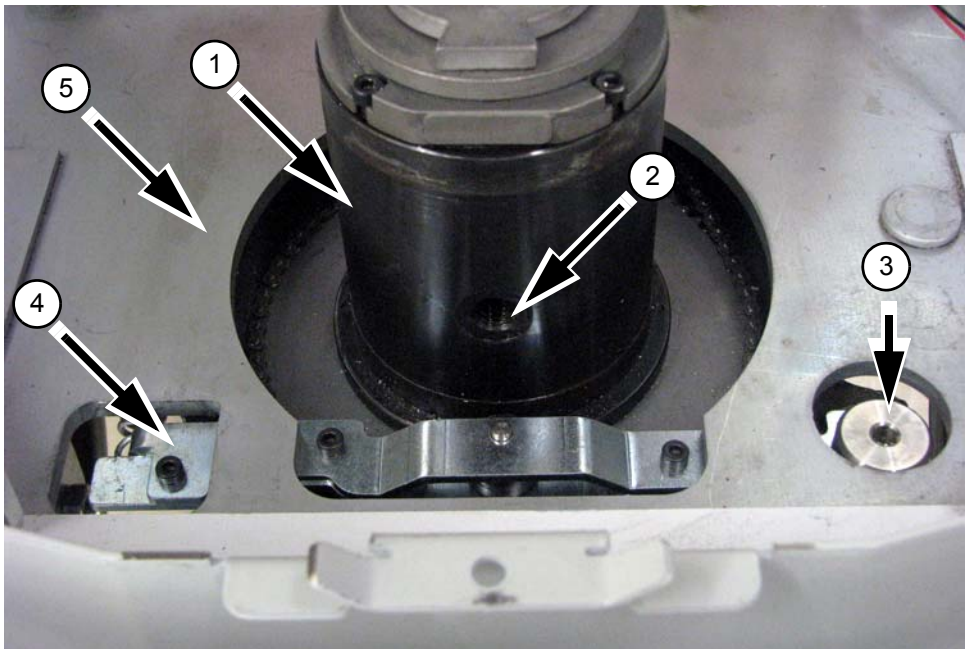
8.4.6.3 Procedure

1. Identify the parts used in this procedure. See Figure 8-46 and Figure 8-47.



Item	Description
1	Rotational Detent Arm (spring loaded)
2	Eccentric Stud Nut
3	Column Support Assembly
4	Column Mount Trap Spacer (bracket)
5	Allen wrench used to hold Rotational Detent Arm out
6	Spring Applied Brake electric cable

Figure 8-46 Parts Description (underside)



Item	Description
1	Column Inner Sleeve
2	Column Mounting Bolt hole
3	Eccentric Stud
4	Rotational Detent Arm (spring loaded)
5	Base of Thorax

Figure 8-47 Parts Description (topside)

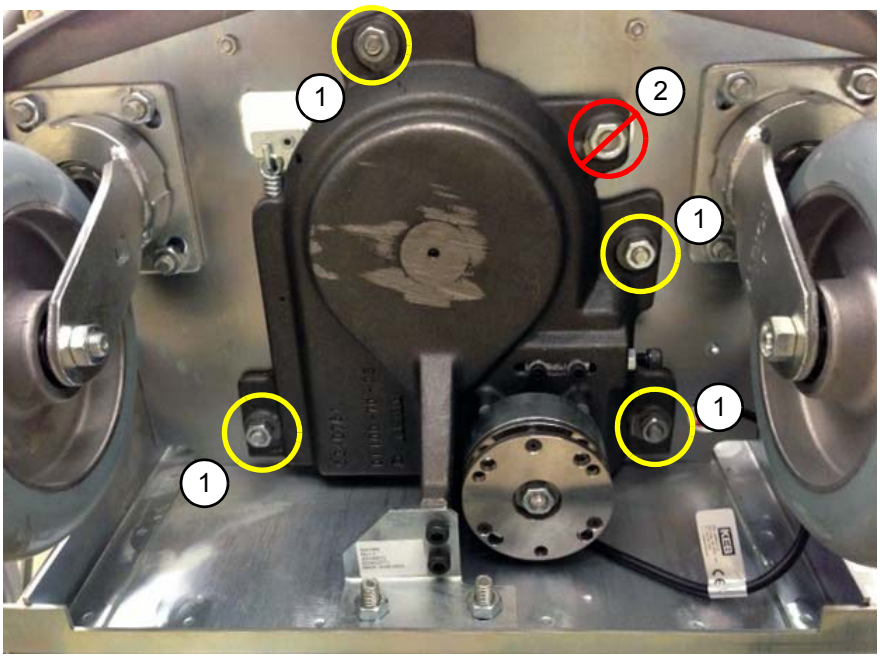
2. Disconnect the Spring Applied Brake electrical connection and feed cable to bottom side of base assembly. See Figure 8-46.
3. See Figure 8-46 and Figure 8-48. Locate the Column Mount Trap Spacer Bracket on the underside of the system. Remove the two lower nuts, and two cap head screws. Then remove the Column Mount Trap Spacer Bracket.

Figure 8-48 Column Mount Trap Spacer Bracket

⚠ CAUTION

HEAVY WEIGHT: THE COLUMN SUPPORT ASSEMBLY WEIGHS APPROXIMATELY 25LBS (11.3KG) AND COULD CAUSE INJURY IT IF FALLS ON YOUR BODY. USE APPROPRIATE TOOLS TO LOWER THE ASSEMBLY IF NEEDED.

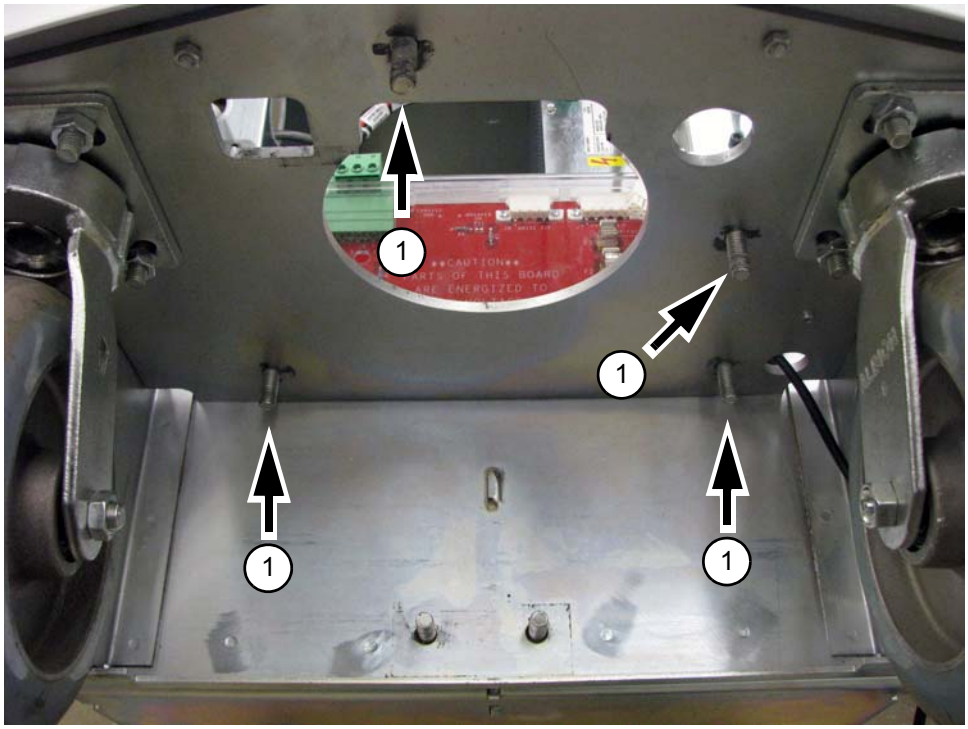
4. See Figure 8-49. From the underside of the system remove the four nuts holding the Column Support Assembly. Do not remove the Eccentric Stud Nut used on the Rotational Detent Arm. Note you will need to support the weight of the Column Support Assembly while removing these nuts to prevent the assembly from falling. You may also consider leaving some of the nuts partially threaded to hold the Column Support Assembly up while performing the next step.



Item	Description
1	Remove these nuts
2	DO NOT REMOVE THIS NUT

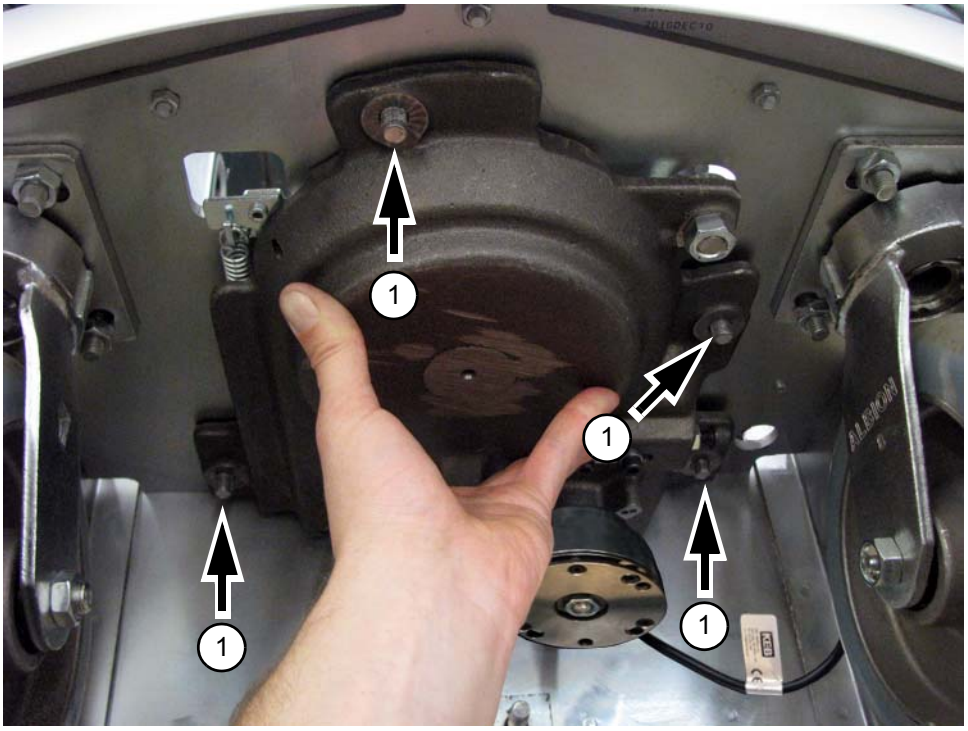
Figure 8-49 Four nuts holding the Column Support Assembly

5. Lower the Column Support Assembly from the thorax. Since the assembly aligns with the four studs, it has to be lowered evenly. You may need to pry the assembly down with a large screwdriver if it does not come down easily.
6. See Figure 8-50 and Figure 8-51. Apply thread locker to the four studs. Lift new Column Support Assembly into position. Torque the four nuts holding the casting to the base to 25.0 N-m (18.44 ft-lb).



Item	Description
1	Apply thread locker to studs

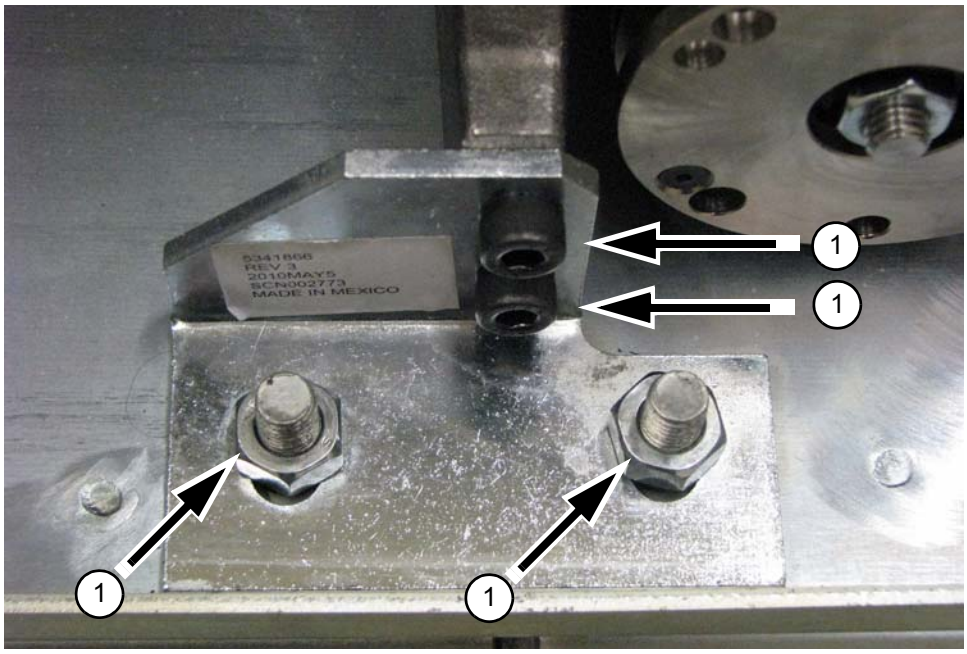
Figure 8-50 Apply thread locker to studs before installing new Column Support Assembly



Item	Description
1	Torque nuts to 25.0 N-m (18.44 ft-lb)

Figure 8-51 Lifting the Column Support Assembly into place

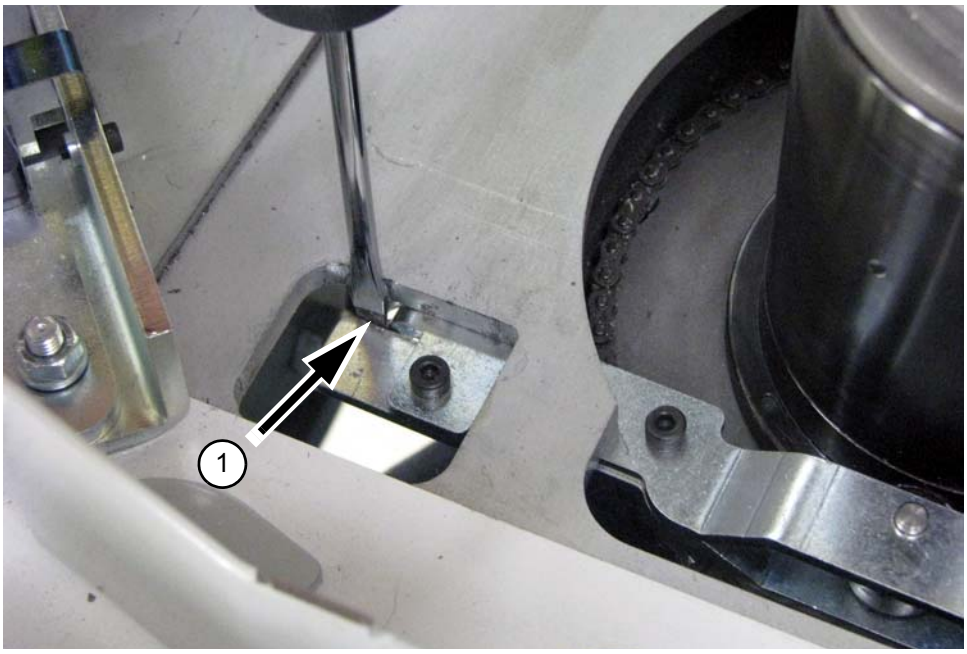
7. See Figure 8-52. Apply thread locker and attach the four fasteners holding the Column Mount Spacer (Bracket) to the system. It's recommended that all four fasteners be hand tightened first, and then they can all be torqued to 20.0 N-m (14.75 ft-lb).



Item	Description
1	Torque fasteners to 20.0 N-m (14.75 ft-lb)

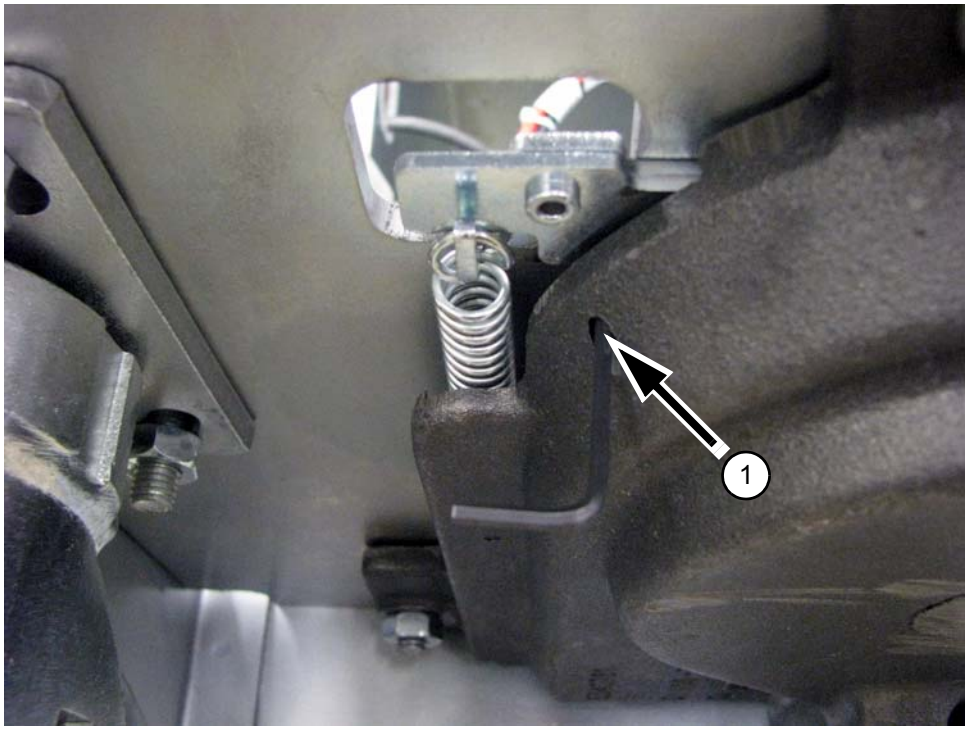
Figure 8-52 Fasteners holding the Column Mount Trap Spacer (Bracket)

8. See Figure 8-53 and Figure 8-54. Use a large screwdriver at the base of the Thorax to move the spring-loaded column rotational detent arm (Figure 8-52) toward the front of the unit. From underneath the base, insert a 4mm (5/32") Allen wrench into the hole in the cover (Figure 8-53) to hold the rotational detent arm away from the column.



Item	Description
1	Pry out detent arm

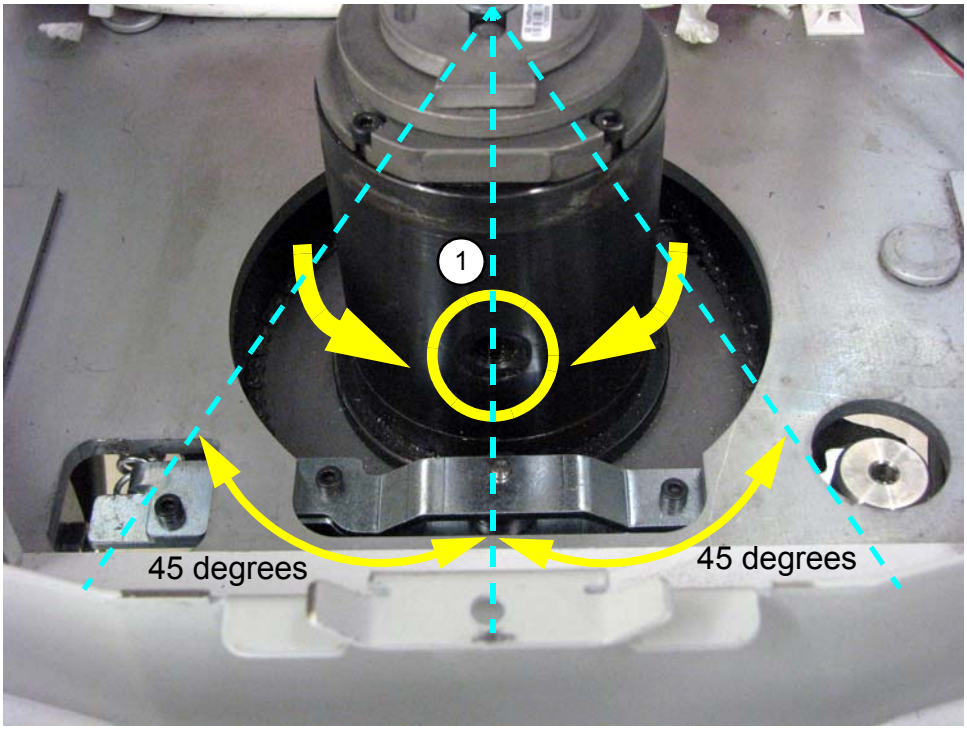
Figure 8-53 Prying the Rotational Detent Arm out with a flathead screwdriver



Item	Description
1	Insert Allen wrench here

Figure 8-54 Inserting the Allen wrench to hold the Rotational Detent Arm out

9. See Figure 8-55. Ensure the main column mounting bolt hole is facing the general direction of the front bumper, this will make the installation of the column mounting bolt easier. If needed, rotate the Column Inner Sleeve by hand to face the bolt hole towards the front of the system.
   a. To rotate by hand, you must remove the brake assembly. Note, this may not be necessary as the replacement part should already be pre-positioned.
   b. See 8.4.5 Spring applied brake (column rotational brake) on page 200.
   c. Re-install the brake assembly before attempting to install the column.



Item	Description
1	Position bolt hole towards the front
	Bolt hole position range +/- 45 degrees from center as shown

Figure 8-55 Ensuring the Column Bolt Hole is facing the front of the system

10. Using two people lift the column into position on the chassis and install the column mounting bolt. Torque to 90 N-m (66.4 ft-lb), no thread locker is used.
11. Pry out the Rotational Detent Arm with a Flathead screwdriver and remove the Allen wrench that was used to hold the rotational detent arm out.
12. Install the cable bracket onto the column.
13. Install the horizontal arm and the X-ray tube. See 8.6.3 Horizontal arm assembly on page 327. See Figure 8-21, Figure 8-22 and Figure 8-23 for cable routing at the rear of the X-ray tube.
14. Install the collimator. See 8.6.9 Collimator on page 358.
15. Install cable brackets and cable ties.

NOTICE

Examine the steel cables at the top of the column to ensure proper tension has been maintained prior to unlocking the vertical carriage. If the safety lock has been engaged, disengaging the vertical carriage lock can result in uncontrolled cable tension and/or equipment damage, resulting in column replacement. For details on releasing the safety lock, see Column Replacement, 8.6.2.3 Procedure on page 318.

16. Unlock the vertical carriage. See 8.6.1 Engaging vertical lock on page 315.
17. Check and adjust the mechanical alignment of the column rotational detent position. See 6.1.3 Column rotational detent procedure on page 111.

18. Install the column top cover. See 8.1.2 Top cover removal on page 150.
19. Install the column skirt covers. See 8.1.6 Column skirt cover removal on page 160.
20. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
21. Install the front covers. See 8.1.3 Front cover removal on page 152.
22. Install the side covers. See 8.1.1 Side cover removal on page 150.

8.4.6.4 Finalization

1. Perform the following mechanical alignments:
   - Check and adjust the mechanical alignment of the column rotational detent position. See 6.1.3 Column rotational detent procedure on page 111.
   - Check and adjust the mechanical alignment of the park latch assembly and arm yoke for the arm retracted position for smooth and repeatable operation. See 6.1.2 Tube latch to arm pin adjustment procedure on page 108.
   - Check and adjust the Column Balance. See 6.1.1 Column balance procedure on page 105.
2. Perform the following HHS checks:
   - Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117
3. Perform the following functional checks:
   - Tube column and arm - see Tube column and arm on page 35
   - X-ray - see X-ray on page 36
4. This step applies to Optima XR220amx and Optima XR200amx with digital upgrade systems only:
   - Perform QAP. See the Optima XR220amx Operator Manual, Quality Assurance and Maintenance chapter.

8.4.7 Rear bin kickplate

8.4.7.1 Personnel requirements

Required persons: 1

Timing (min): 20

8.4.7.2 Preliminary requirements

8.4.7.2.1 Tools and test equipment

- Standard tool kit

8.4.7.2.2 Consumables

- None

8.4.7.2.3 Replacement parts

Item: Kickplate

Quantity: 1

8.4.7.2.4 Safety

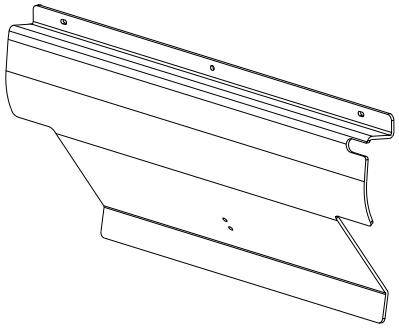
- None

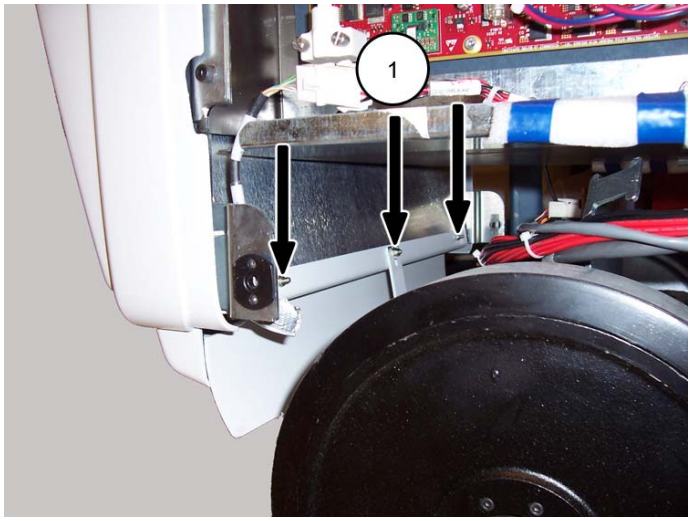
8.4.7.2.5 Required conditions

- Remove the side covers. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.4.7.3 Procedure

1. Access the mounting nuts through the openings behind the drive wheels.
2. Remove the mounting nuts (3) from the rear of the kickplate, then remove the kickplate. See Figure 8-56.





Item	Description
1	Mounting nuts (3)

Figure 8-56 Kickplate

3. Install the new kickplate and mounting nuts.
4. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
5. Install the side covers.

8.4.7.4 Finalization

None

8.4.8 Rear bin mounting bracket - Optima XR200amx only

8.4.8.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.4.8.2 Preliminary requirements

8.4.8.2.1 Tools and test equipment

- Standard tool kit

8.4.8.2.2 Consumables

- None

8.4.8.2.3 Replacement parts

Item: Rear bin mounting bracket

Quantity: 1

8.4.8.2.4 Safety

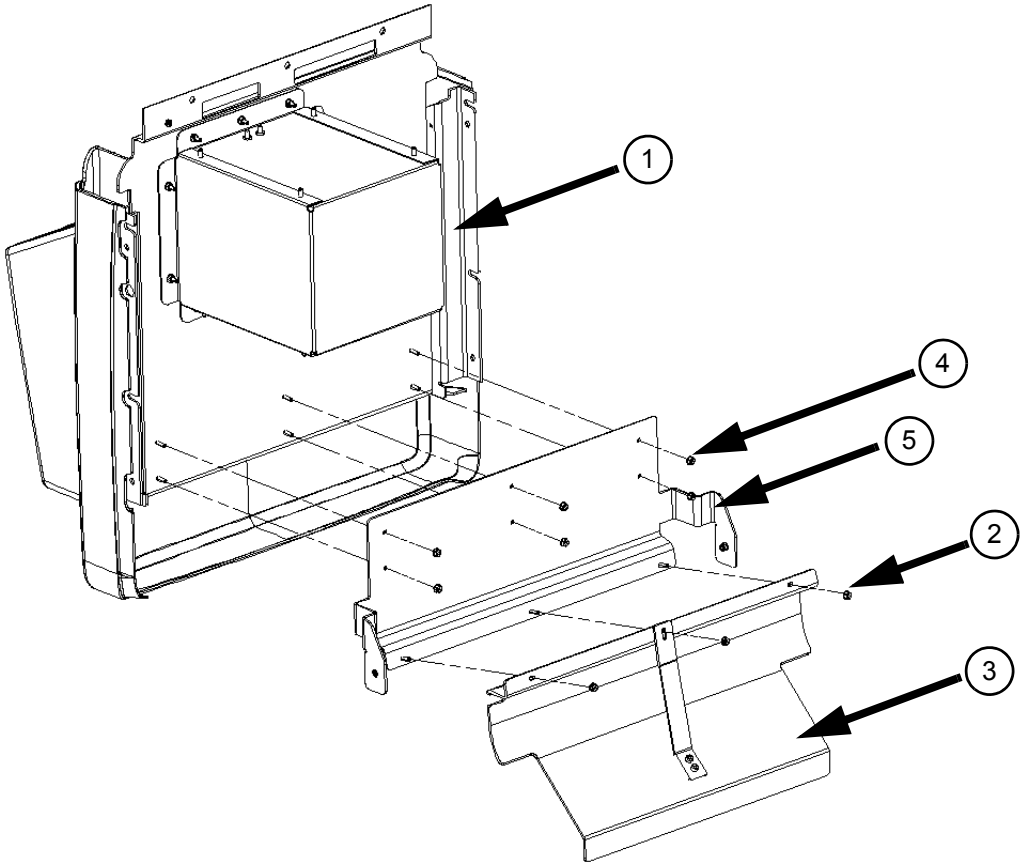
- None

8.4.8.2.5 Required conditions

- Remove the side covers and the rear bin. See 8.1.5 Rear bin removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.4.8.3 Procedure

1. See Figure 8-57. Remove the kickplate mounting nuts (Item 2) and kickplate (Item 3).
2. Remove the mounting bracket nuts (Item 4) and mounting bracket (Item 5) from the rear bin (Item 1).



Item	Description
1	Rear bin
2	Rear bin kickplate mounting nuts (3 used)
3	Rear bin kickplate
4	Rear bin mounting bracket mounting nuts (6 used)
5	Rear bin mounting bracket)

Figure 8-57 Rear bin assembly

3. Attach the new mounting bracket to the rear bin. Install and tighten the mounting nuts.
4. Attach the kickplate to the mounting bracket. Install and tighten the mounting nuts.
5. Attach the rear bin assembly to the chassis. Install and tighten the mounting screws.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the sides covers.

8.4.8.4 Finalization

None

8.4.9 Motor brake and motor reducer assembly

8.4.9.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.4.9.2 Preliminary requirements

8.4.9.2.1 Tools and test equipment

- Standard tool kit

8.4.9.2.2 Consumables

- None

8.4.9.2.3 Replacement parts

Item: Motor reducer assembly and/or motor brake

Quantity: 1

8.4.9.2.4 Safety

- None

8.4.9.2.5 Required conditions

- Remove the side covers and the rear bin. See 8.1.5 Rear bin removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Remove the drive wheels. See 8.4.1 Drive wheel.

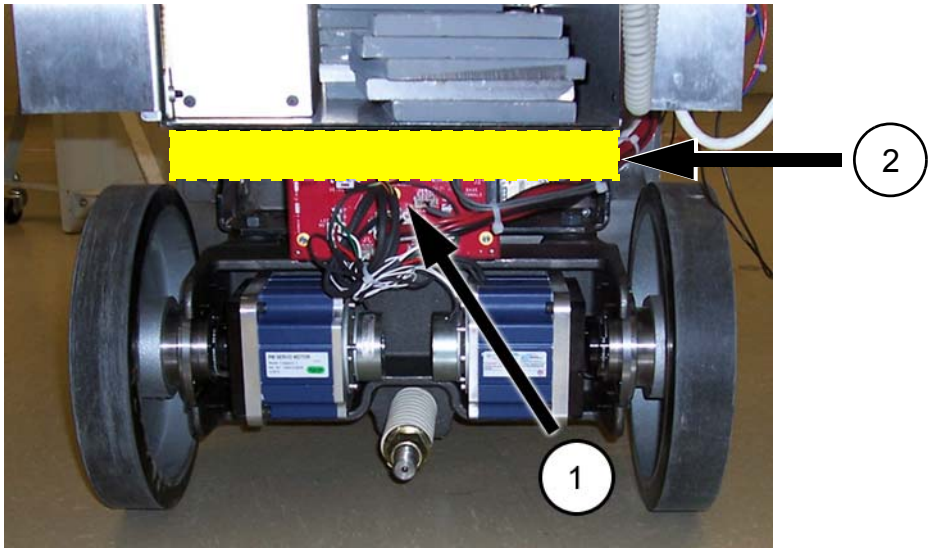
8.4.9.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

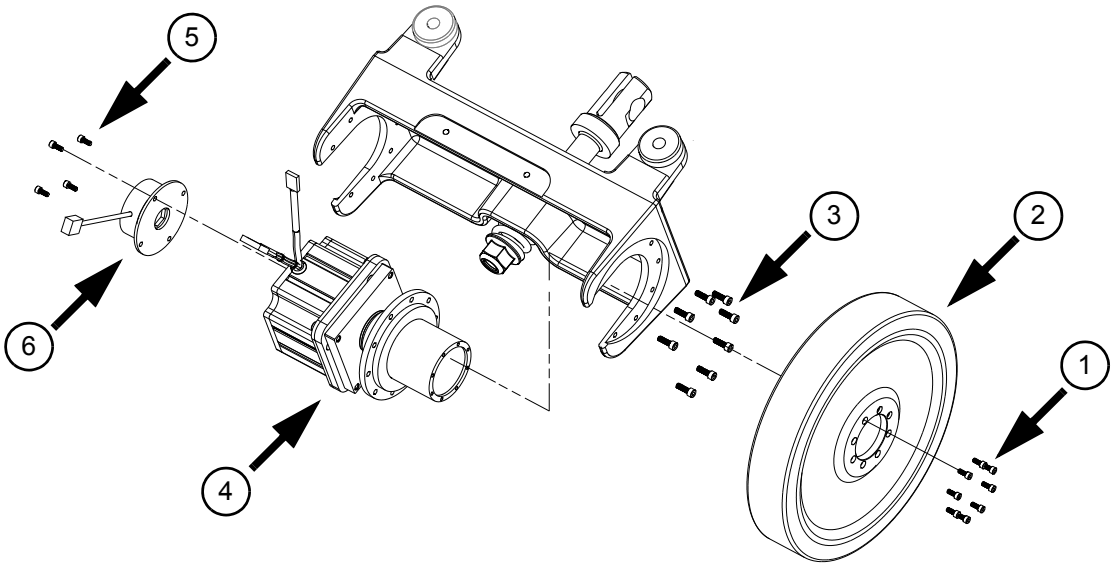
1. See Figure 8-58. Disconnect the three cables running from the motor/brake assembly to the Caterpillar board (Item 1).



Item	Description
1	Caterpillar base transition board
2	Steel counterweight

Figure 8-58 Caterpillar board

2. See Figure 8-59. Remove the eight motor mounting screws (Item 3) and the motor/brake assembly (Items 4 & 6).



Item	Description
1	Drive wheel mounting screws (8 used)
2	Drive wheel
3	Motor mounting screws (8 used)
4	Motor
5	Brake mounting screws (4 used)
6	Brake

Figure 8-59 Drive assembly (right side shown)

3. Before removing the brake, note the position of the cable exiting the brake so that the brake can be mounted to the new motor in the same orientation.
4. Remove the brake mounting screws (Item 5) and the brake (Item 6) from the motor (Item 4).
5. Install the brake onto the motor (the brake should be positioned so that the cable comes out towards the top). Torque to 3 N-m (2.2 lb-ft).
6. Install the motor/brake assembly into the chassis. Install the eight mounting screws and tighten them in an alternating pattern. Torque to 5 N-m (3.7 lb-ft).
7. Plug the three cables into the Caterpillar board.
   The left motor/brake assembly cables plug into connectors J3, J4 and J7.
   The right motor/brake assembly cables plug into connectors J5, J6 and J9.
8. Install the drive wheel onto the hub, install the eight mounting screws and tighten them in an alternating pattern. Torque to 3 N-m (2.2 lb-ft).
9. Lift the unit and remove the support blocks.
10. Install the rear bin.
11. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
12. Install the side covers.

8.4.9.4 Finalization

None

8.4.10 Caterpillar base transition board

8.4.10.1 Personnel requirements

Required persons: 1
Timing (min): 105

8.4.10.2 Preliminary requirements

8.4.10.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.4.10.2.2 Consumables

- None

8.4.10.2.3 Replacement parts

Item: Caterpillar base transition circuit board
Quantity: 1

8.4.10.2.4 Safety

- None

8.4.10.2.5 Required conditions

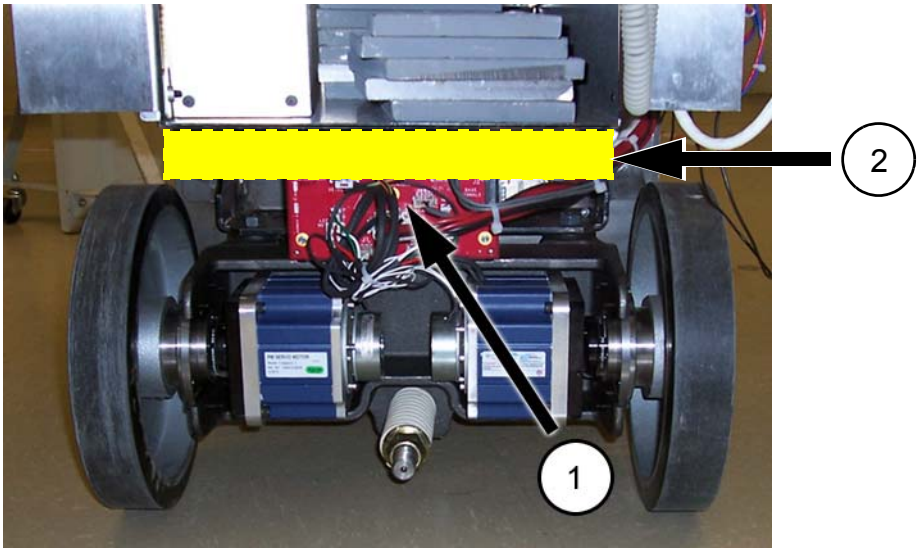
- Remove the side covers and the rear bin. See 8.1.5 Rear bin removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.4.10.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Locate the circuit board. See Figure 8-60.



Item	Description
1	Caterpillar base transition board
2	Steel counterweight

Figure 8-60 Board identification - lower rear

2. Disconnect all cables (11 connections) from the circuit board.
3. Remove the old circuit board (5 screws).
4. Install the new circuit board.
5. Connect all cables to the circuit board.
6. Install the rear bin.
7. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
8. Install the side covers.

8.4.10.4 Finalization

Perform the following functional checks:

- Drive - see Drive on page 35

Section 8.5 Thorax assembly

8.5.1 Spyder system controller

8.5.1.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.1.2 Preliminary requirements

8.5.1.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.1.2.2 Consumables

- None

8.5.1.2.3 Replacement parts

Item: Spyder system controller board

Quantity: 1

Note: The Spyder controller board is different in Brivo and Optima system configurations. You must use the correct Spyder board part number for all replacements. Failure to use the correct board will result in erratic system behavior and/or system non-functionality, including non-recoverable Spyder board damage.

8.5.1.2.4 Safety

- None

8.5.1.2.5 Required conditions

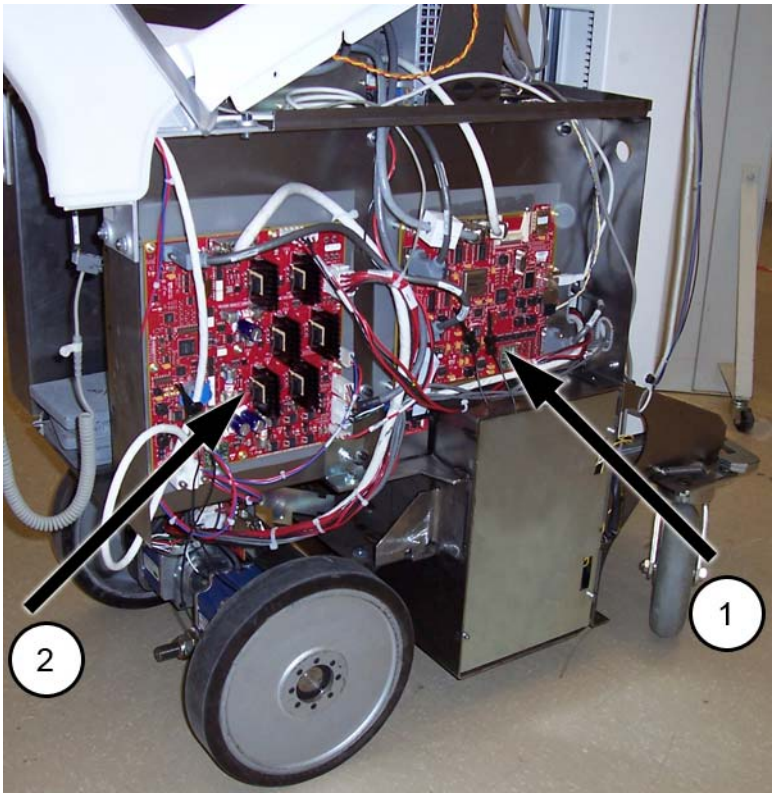
- Remove the right side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.1.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Locate the circuit board. See Figure 8-61.



Item	Description
1	Spyder system controller board
2	Locust drive board

Figure 8-61 Board identification - right side

2. Disconnect all cables (9 - 13 connections, depending on configuration) from the circuit board.
3. Remove the old circuit board (4 screws).
4. Install the new circuit board.
5. Connect all cables to the circuit board.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the right side cover.

8.5.1.4 Finalization

The system will report a `BDM Mismatch` error detected with 2 selections:

RESTORE and CANCEL

Make sure you select RESTORE to have the Board Data Module upload the correct contents to the Spyder board. Failure to do so will result in erratic or failed system functionality. Recovery requires a complete firmware download and system calibrations.

Perform the following functional checks:

- Drive - see Drive on page 35
- X-ray - see X-ray on page 36

8.5.2 Locust drive board

8.5.2.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.2.2 Preliminary requirements

8.5.2.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.2.2.2 Consumables

- None

8.5.2.2.3 Replacement parts

Item: Locust drive circuit board

Quantity: 1

8.5.2.2.4 Safety

- None

8.5.2.2.5 Required conditions

- Remove the right side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.2.3 Procedure

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Locate the circuit board. See Figure 8-61.
2. Disconnect all cables (9 connections) from the circuit board.
3. Remove the old circuit board (9 screws).
4. Install the new circuit board.
5. Connect all cables to the circuit board.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the right side cover.

8.5.2.4 Finalization

The system will report a `BDM Mismatch` error detected with 2 selections:

RESTORE and CANCEL

Make sure you select RESTORE to have the Board Data Module upload the correct contents to the Locust board. Failure to do so will result in erratic or failed system functionality. Recovery requires a complete firmware download and system calibrations.

1. Perform the following calibrations:
   - Drive handle - see Drive on page 35
2. Perform the following functional checks:
   - Drive - see Drive on page 35
   - Tube column & arm (locks & latches) - see Tube column and arm on page 35

8.5.3 Locust drive board fuses

8.5.3.1 Personnel requirements

Required persons: 1

Timing (min): 10

8.5.3.2 Preliminary requirements

8.5.3.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.3.2.2 Consumables

- None

8.5.3.2.3 Replacement parts

Item: Locust drive board fuses

Quantity: As required

8.5.3.2.4 Safety

- None

8.5.3.2.5 Required conditions

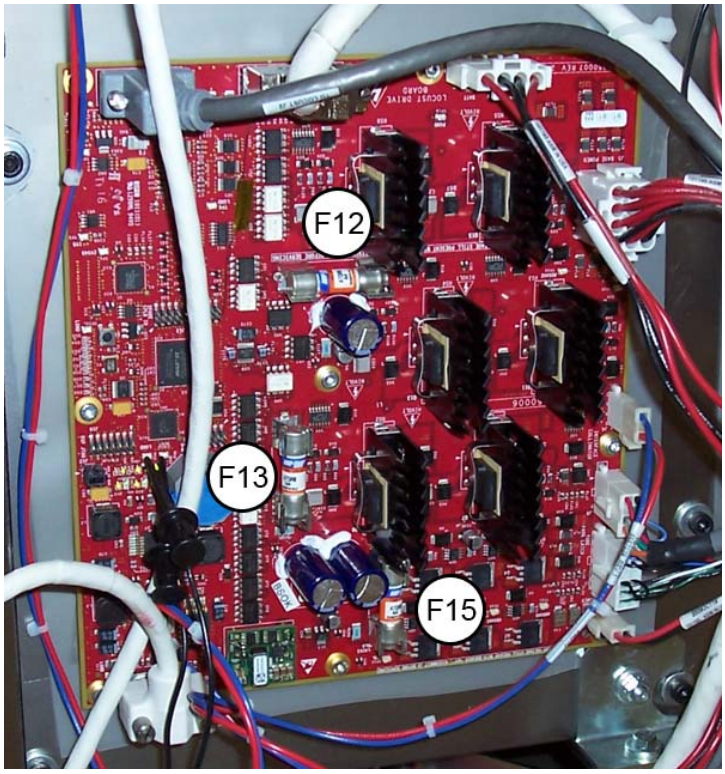
- Remove the right side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.3.3 Procedure

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Locate the circuit board. See Figure 8-61.
2. Locate the bad fuse. See Figure 8-62.



Item	Description
F12	Right motor fuse: 8A, time delay, 300vdc, 600vac
F13	Left motor fuse: 8A, time delay, 300vdc, 600vac
F15	Locks fuse: 8A, time delay, 300vdc, 600vac

Figure 8-62 Locust board fuses

3. Remove the old fuse.
4. Install the new fuse.
5. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
6. Install the right side cover.

8.5.3.4 Finalization

Perform the following functional checks:

- Drive (brake solenoids) - see Drive on page 35
- Tube column & arm (locks & latches) - see Tube column and arm on page 35

8.5.4 Firefly charger board

8.5.4.1 Personnel requirements

Required persons: 1
Timing (min): 30

8.5.4.2 Preliminary requirements

8.5.4.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.4.2.2 Consumables

- None

8.5.4.2.3 Replacement parts

Item: Firefly charger circuit board
Quantity: 1

8.5.4.2.4 Safety

- None

8.5.4.2.5 Required conditions

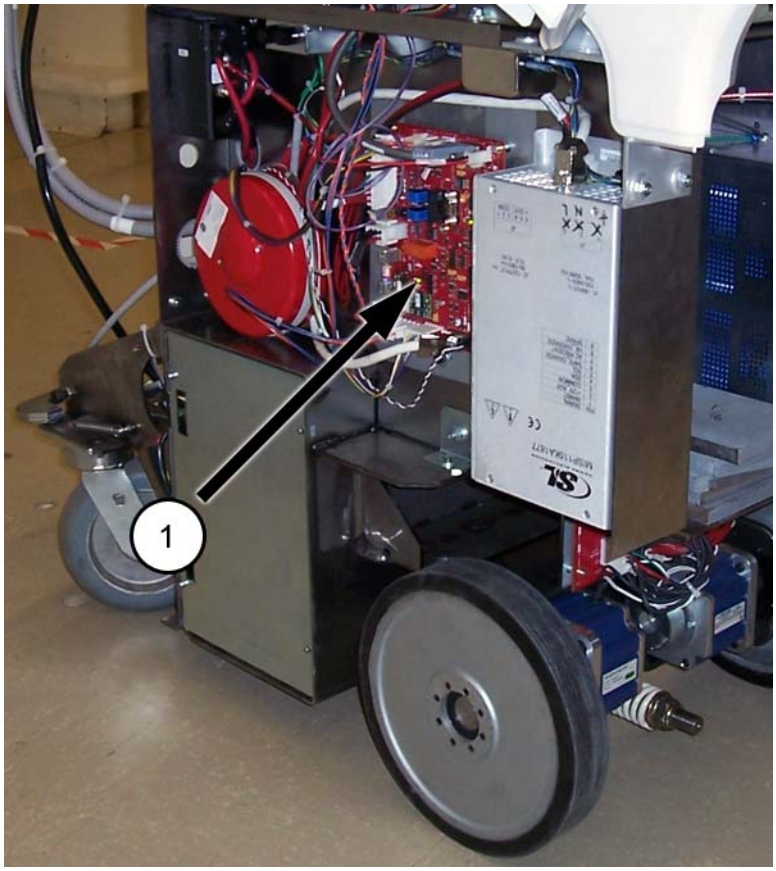
- Remove the left side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.4.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Locate the circuit board. See Figure 8-63.



Item	Description
1	Firefly charger board

Figure 8-63 Board identification - left side

2. Remove the Firefly board safety shield.
3. Disconnect all cables from the circuit board.
4. Remove the old circuit board.
5. Install the new circuit board.
6. Connect all cables to the circuit board.
7. Install the Firefly board safety shield.
8. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.

9. Install the left side cover.

8.5.4.4 Finalization

The system will report a `BDM Mismatch` error detected with 2 selections:

RESTORE and CANCEL

Make sure you select RESTORE to have the Board Data Module upload the correct contents to the Firefly board. Failure to do so will result in erratic or failed system functionality. Recovery requires a complete firmware download and system calibrations.

Perform the following functional checks:

- Charging - see Charging on page 35

8.5.5 Firefly board fuses

8.5.5.1 Personnel requirements

Required persons: 1

Timing (min): 10

8.5.5.2 Preliminary requirements

8.5.5.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.5.2.2 Consumables

- None

8.5.5.2.3 Replacement parts

Item: Firefly board fuses

Quantity: As required

8.5.5.2.4 Safety

- None

8.5.5.2.5 Required conditions

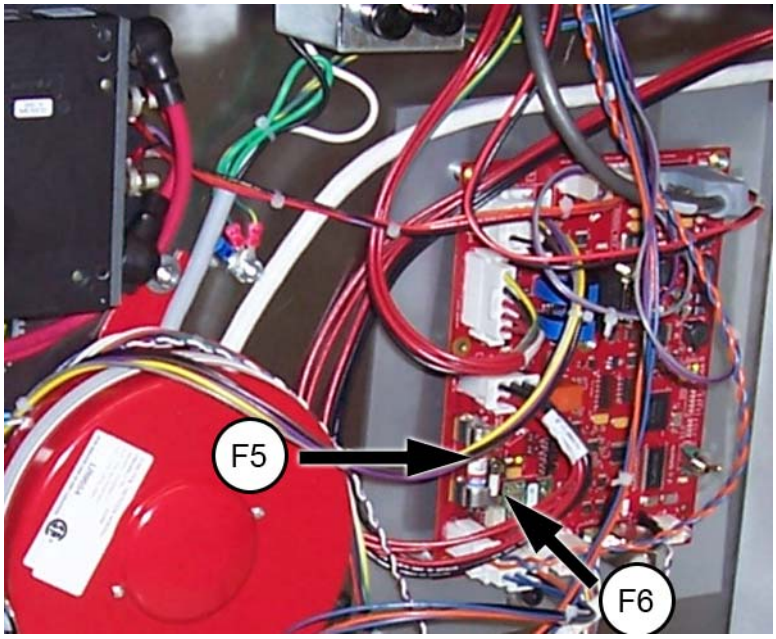
- Remove the left side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.5.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Locate the circuit board. See Figure 8-63.
2. Remove the Firefly safety shield.
3. Locate the bad fuse. See Figure 8-64.



Item	Description
F5	Power-in for Mantis (from batteries): 15A, time delay, 300vdc, 600vac
F6	Power-in for collimator lamp power supply (from batteries): 3.15A, time delay, 5x20mm, 250V, 1.5kA interrupt, ceramic

Figure 8-64 Firefly board fuses

4. Remove the old fuse.
5. Install the new fuse.
6. Install Firefly board safety shield.
7. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
8. Install the left side cover.

8.5.5.4 Finalization

Perform the following functional checks:

- Charging - see Charging on page 35

8.5.6 Cricket battery board

8.5.6.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.6.2 Preliminary requirements

8.5.6.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.6.2.2 Consumables

- Cable ties

8.5.6.2.3 Replacement parts

Item: Cricket battery circuit board

Quantity: 1

8.5.6.2.4 Safety

- None

8.5.6.2.5 Required conditions

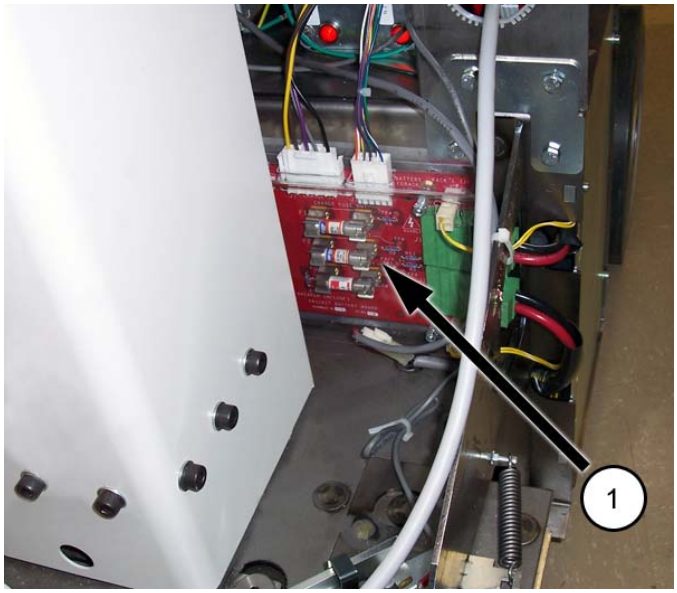
- Remove the side covers and front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.6.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Locate the circuit board. See Figure 8-65.



Item	Description
1	Cricket battery board

Figure 8-65 Board identification - front

2. Disconnect all cables from the circuit board. Some of these connectors pass through the plastic safety shield and must be removed before the safety shield can be removed. For the smaller connectors, use a screwdriver to press on the release latch on the side of the connector body.
3. Remove the mounting screws (two on each side) for the plastic safety shield.
   Note: Remove the cable ties from the bottom of the safety shield only if necessary.
4. Remove the old circuit board (4 standoffs).
5. Install the new circuit board.
6. Install the plastic safety shield and cable/cable ties.
7. Connect all cables to the circuit board.
8. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
9. Install the front cover.
10. Install the side covers.

8.5.6.4 Finalization

Perform the following functional checks:

- Drive - see Drive on page 35
- X-ray - see X-ray on page 36
- Charging - see Charging on page 35

8.5.7 Cricket board fuses

8.5.7.1 Personnel requirements

Required persons: 1

Timing (min): 10

8.5.7.2 Preliminary requirements

8.5.7.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.7.2.2 Consumables

- Cable ties

8.5.7.2.3 Replacement parts

Item: Cricket board fuses

Quantity: As required

8.5.7.2.4 Safety

- None

8.5.7.2.5 Required conditions

- Remove the side covers and front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

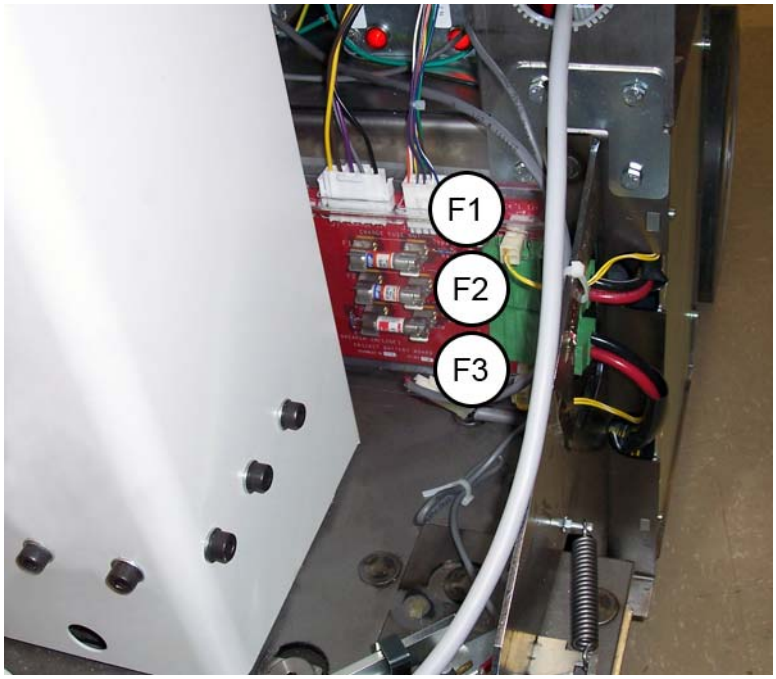
8.5.7.3 Procedure

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Locate the circuit board. See Figure 8-65.
2. Disconnect the cables from the front and top of the circuit board. These connectors pass through the plastic safety shield and must be removed before the safety shield can be removed. For the smaller connectors, use a screwdriver to press on the release latch on the side of the connector body.

3. Remove the mounting screws (two on each side) from the plastic safety shield.
   Note: Remove the cable ties from the bottom of the safety shield only if necessary.
4. Locate the bad fuse. See Figure 8-66.



Item	Description
F1	Charge fuse
F2	Drive fuse 1
F3	Drive fuse 2

Figure 8-66 Cricket board fuses

5. Remove the old fuse and replace it with the new fuse.
6. Install the plastic safety shield and cable/cable ties.
7. Connect the cables to the circuit board.
8. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
9. Install the front covers.
10. Install the side covers.

8.5.7.4 Finalization

Perform the following functional checks:

- Charging - see Charging on page 35
- Drive - see Drive on page 35

8.5.8 Hornet UIF board

8.5.8.1 Personnel requirements

Required persons: 1

Timing (min): 45

8.5.8.2 Preliminary requirements

8.5.8.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.8.2.2 Consumables

- Cable ties

8.5.8.2.3 Replacement parts

Item: Hornet UIF circuit board

Quantity: 1

8.5.8.2.4 Safety

- None

8.5.8.2.5 Required conditions

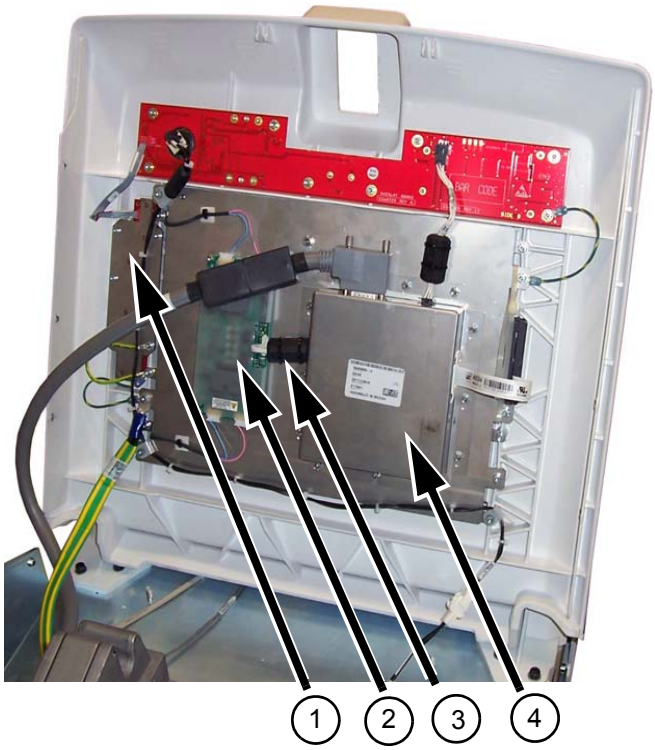
- Remove the side covers and the top cover. See 8.1.2 Top cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.8.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. See Figure 8-67. On the rear of the top cover, locate the Hornet circuit board which is under a metal cover (Item 4).



Item	Description
1	Drive login board assembly
2	Display inverter
3	Ferrite core
4	Hornet UIF board metal cover
5	Cable clamp

Figure 8-67 Board identification - top cover

2. Disconnect two cables from the top of the Hornet board.
3. Disconnect one cable from the right side of the Hornet board.
4. On the left side of the Hornet board, unplug the other end of the cable from the display inverter board (Item 2).

5. Remove cables ties from the ferrite core (Item 3) and remove the core from the cable.
6. Remove the 12 mounting nuts and the metal cover (Item 4).
7. Disconnect the remaining cable from the bottom of the Hornet board.
8. Remove the old Hornet board (4 screws).
9. Install the new circuit board.
10. Connect the cable to the bottom of the Hornet board.
11. Transfer the cable from the left side of the old Hornet board to the new board.
12. Route the left-side cable through the metal cover, then install the cover and mounting nuts.
13. Connect all remaining cables to the circuit board.
14. Connect the left-side cable to the display inverter board.
15. Re-install the ferrite core onto the cable and secure with cable ties.
16. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
17. Install the top cover and side covers.

8.5.8.4 Finalization

1. Perform the following calibrations:
   - Touchscreen - see Section 5.2 Touchscreen calibration on page 89
2. Perform the following HHS checks:
   - Generator Operator Indicators - see 7.1.6 Testing generator operator indicators on page 131

8.5.9 Drive login active board collector

8.5.9.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.9.2 Preliminary requirements

8.5.9.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.9.2.2 Consumables

- None

8.5.9.2.3 Replacement parts

Item: Drive login active board collector

Quantity: 1

8.5.9.2.4 Safety

- None

8.5.9.2.5 Required conditions

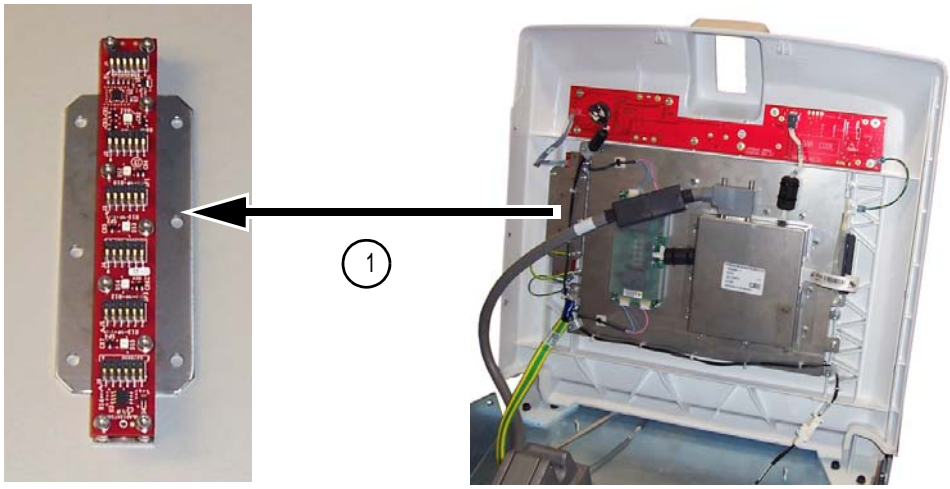
- Remove the side covers and the top cover. See 8.1.2 Top cover removal.

- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.9.3 Procedure

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Locate the drive login board assembly. See Figure 8-68.
2. Remove the drive login board assembly (6 screws) from the top cover.
3. Remove the drive login board from the assembly (9 screws). See Figure 8-68.



Item	Description
1	Drive login board assembly

Figure 8-68 Drive login board assembly

4. Disconnect the cable from the circuit board.
5. Connect the cable to the new circuit board.
6. Install the new circuit board on the assembly.
7. Install the assembly on the top cover.
8. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
9. Install the top cover.
10. Install the side covers.

8.5.9.4 Finalization

Perform the following functional checks:

- Drive (drive login) - see Drive on page 35

8.5.10 Top cover or display & inverter collector

8.5.10.1 Personnel requirements

Required persons: 1

Timing (min): 60

8.5.10.2 Preliminary requirements

8.5.10.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.10.2.2 Consumables

- Cable ties

8.5.10.2.3 Replacement parts

Item: Top cover or display & inverter collector

Quantity: 1

8.5.10.2.4 Safety

- None

8.5.10.2.5 Required conditions

- Remove the side covers and the top cover. See 8.1.2 Top cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.10.3 Procedure

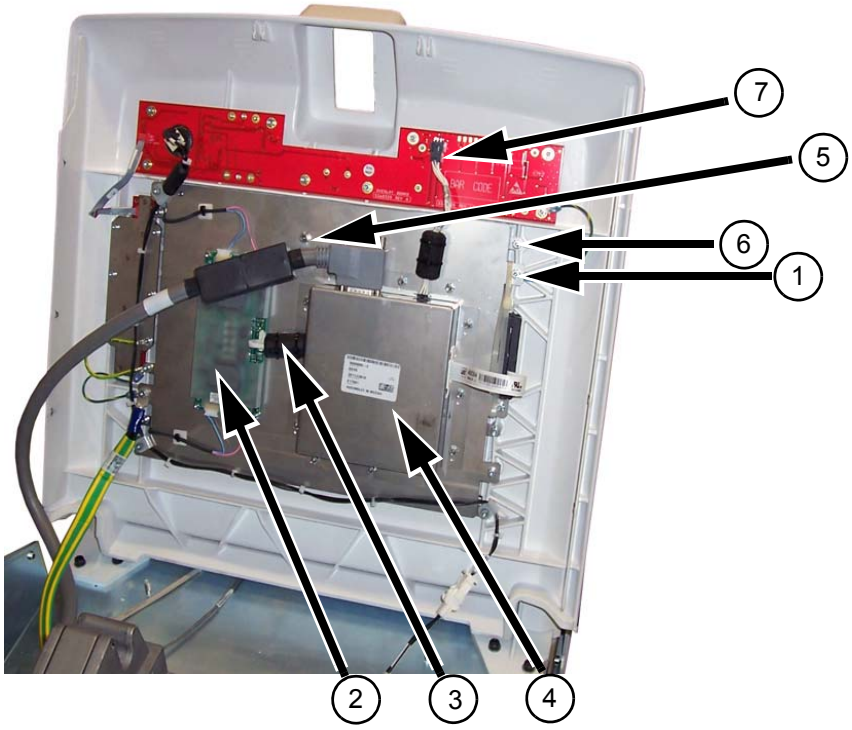
WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

For top cover replacement, perform LOTO, remove appropriate cable connections, install new cover, and perform finalization steps.

If replacing just the display & inverter, follow the steps listed below.

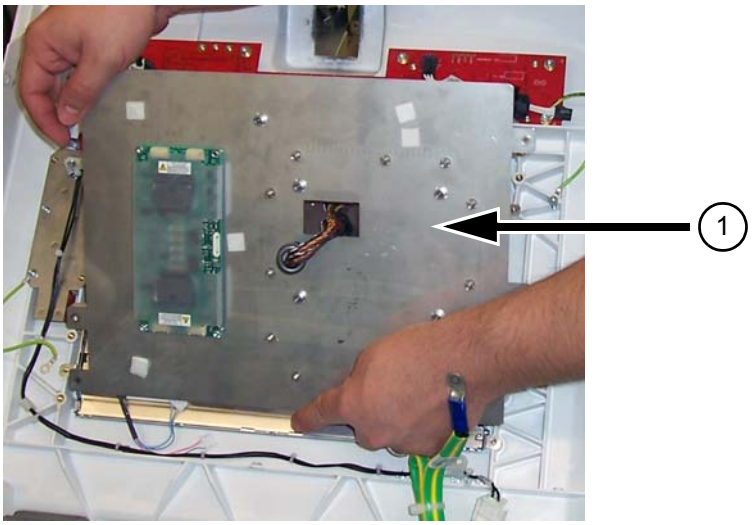
1. See Figure 8-69. On the rear of the top cover, locate the Hornet circuit board which is under a metal cover (Item 4).



Item	Description
1	Display assembly mounting screws (7 screws: 3 on left, 4 on right)
2	Display inverter
3	Ferrite core
4	Hornet UIF board metal cover
5	Cable clamp location (cable clamp not shown)
6	Board mounting plate screws (6 screws: 3 on each side)
7	Hornet to Overlay board cable

Figure 8-69 Board identification - top cover

2. Disconnect two cables from the top of the Hornet board.
3. Remove the cable clamp (Item 5) from the large cable.
4. Disconnect the cable from the right side of the Hornet board.
5. On the left side of the Hornet board, unplug the other end of the cable from the display inverter board (Item 2). Remove cable ties from the ferrite core (Item 3) and remove the core from the cable.
6. Remove the 12 mounting nuts and tip the Hornet board metal cover (Item 4) to gain access to the remaining cable. Disconnect the cable from the left side of the Hornet board. Route the cable connector through the cover and remove the cover.
7. Disconnect the cable from the bottom of the Hornet board.
8. Remove the Hornet board (4 screws).
9. Disconnect the cable from the Overlay board (Item 7)
10. Remove the 4 small cables from the top and bottom of the Display inverter board (Item 2). Note the colors of the cable wires (blue on the left, pink on the right).
11. Remove the 6 screws (3 on each side) and the board mounting plate. See Figure 8-70. Note the locations of cable restraints and ground wires so that they can be properly placed upon re-assembly.

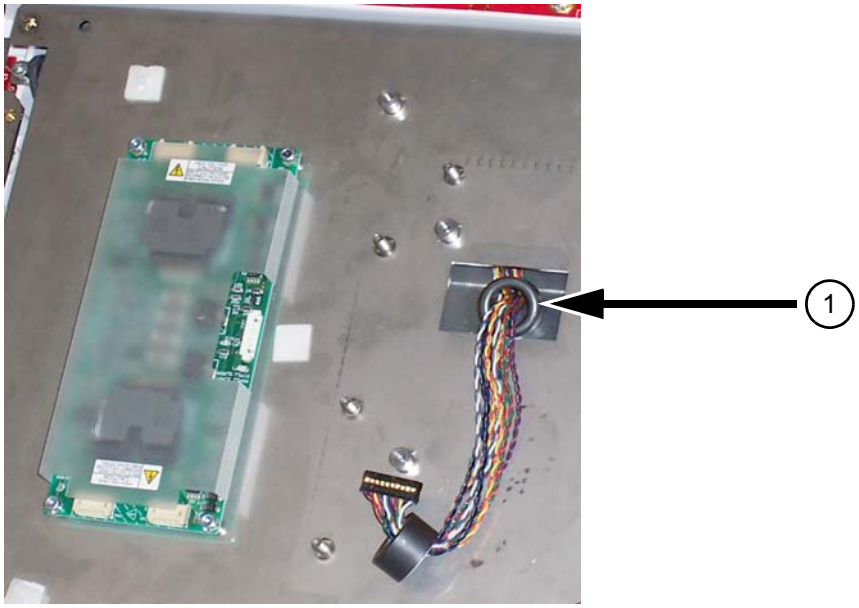


Item	Description
1	Board mounting plate

Figure 8-70 Board mounting plate

12. Remove the 7 display assembly mounting screws (Figure 8-69, Item 1) from the left and right sides.
13. Remove the old display assembly and replace it with the new display assembly.
14. Install the 7 display assembly mounting screws.
15. Route the cable with 2 ferrite cores through the opening in the board mounting plate. Make sure both ferrites are outside of the mounting plate before fastening it down.
16. Install the board mounting plate and 6 mounting screws.
    - Be sure to attach all ground wires and cable clamps in the proper locations.
    - Be careful not to trap any cables or wires underneath the plate.

17. Position the closest ferrite core into the opening in the board mounting plate. See Figure 8-71.



Item	Description
1	Position one ferrite core in opening

Figure 8-71 Ferrite cores

18. Reconnect the 4 small cables to the Display inverter board (blue = left, pink = right).
19. Reconnect the cable to the Overlay board (Figure 8-69, Item 7).
20. Install the Hornet board (4 screws).
21. Connect the cable to the bottom of the Hornet board.
22. Route the left-side cable through the metal cover, plug it into the Hornet board, then install the metal cover and mounting nuts.
23. Connect all remaining cables to the Hornet board.
24. Connect the other end of the left-side cable to the display inverter board. Re-install the ferrite core onto the cable and secure with cable ties.
25. Re-install the cable clamp on the large cable.
26. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
27. Install the top cover and side covers.

8.5.10.4 Finalization

1. Perform the following calibration:
   - Touchscreen - see Section 5.2 Touchscreen calibration on page 89
2. Perform the following HHS checks:
   - Generator operator indicators - see 7.1.6 Testing generator operator indicators on page 131

8.5.11 Board data module

8.5.11.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.11.2 Preliminary requirements

8.5.11.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.11.2.2 Consumables

- None

8.5.11.2.3 Replacement parts

Item: Board data module circuit board

Quantity: 1

8.5.11.2.4 Safety

- None

8.5.11.2.5 Required conditions

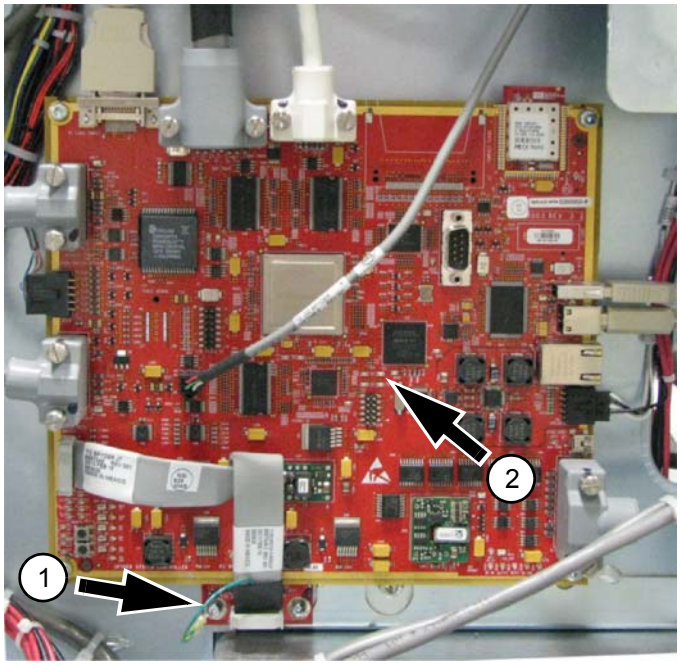
- Remove the right side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.11.3 Procedure

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Disconnect the cable (1 connection) from the circuit board. See Figure 8-72.



Item	Description
1	Board data module
2	Spyder controller circuit board

Figure 8-72 Board identification - right side

2. Remove the old circuit board (2 screws).
3. Install the new circuit board.

Note: There are washers on the front and back of the BDM module. These back side washers MUST be used to properly mount the BDM.

4. Install the fastener previously removed and tighten securely.
   a. Orient the cable ground as shown in Figure 8-72 to prevent accidental shorting.
   b. Ensure washers are properly installed both front and rear.
5. Connect the grounded cable end to the BDM module.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the right side cover.

8.5.11.4 Finalization

The system will report a `BDM Mismatch` error detected with 2 selections:

RESTORE and CANCEL

Make sure you select CANCEL to have the Spyder upload the correct contents to the Board Data Module. Failure to do so will result in erratic or failed system functionality. Recovery requires a complete firmware download and system calibrations.

8.5.12 System PC

8.5.12.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.12.2 Preliminary requirements

8.5.12.2.1 Tools and test equipment

- Standard tool kit
- ESD kit
- External optical drive

8.5.12.2.2 Consumables

- None

8.5.12.2.3 Replacement parts

Item: System PC

Quantity: 1

8.5.12.2.4 Safety

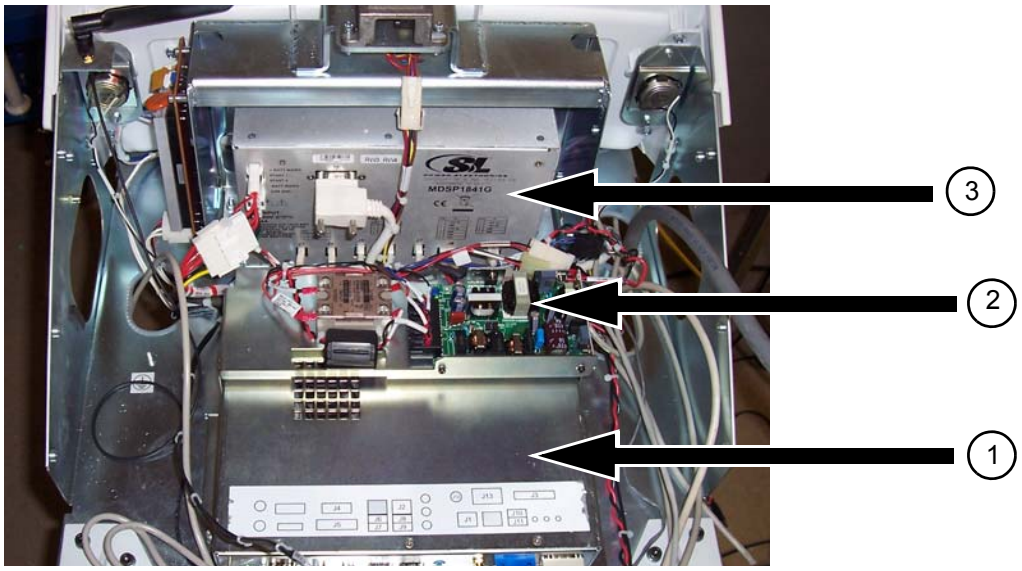
- None

8.5.12.2.5 Required conditions

- Remove the side covers and the top cover. See 8.1.2 Top cover removal.

8.5.12.3 Procedure

1. Perform LOTO on the system.
2. Locate the detector power supply assembly. See Figure 8-73.
3. Remove the two nuts at both ends of the mounting bracket.
4. Locate the System PC. See Figure 8-73.



Item	Description
1	System PC
2	Detector power supply assembly (Optima XR220amx or Optima XR200amx with digital upgrade only)
3	LVLE2 (Low Voltage Low Energy) power supply

Figure 8-73 Assembly identification - under top cover

5. Disconnect all cables (up to 10 connections, depending on configuration) from the PC.
6. Remove the remaining two mounting nuts from the sides of the PC.
7. Lift the detector power supply assembly, then remove the old PC.
8. Place the new PC in position over the mounting studs.
9. Place the detector power supply assembly back in position and install all four mounting nuts.
10. Connect all cables to the PC.
11. Install the top cover.
12. Remove LOTO from the system.

8.5.12.4 Finalization

1. Turn on system power.
2. Perform a load from cold. See Section 3.2 Performing Load From Cold (LFC) on page 44.
3. Configure the system.
4. Restore backup files.
5. Perform the following functional checks:
   - Drive - see Table 2-2 Functional checks on page 35

- X-ray - see Table 2-2 Functional checks on page 35
- Display - see Table 2-2 Functional checks on page 35
- Networking - See Operator Manual for details of networking configuration and testing

6. Perform the following HHS checks:
   - kV accuracy - see 7.1.4.2 Testing kVp accuracy on page 122
   - mAs Accuracy - see 7.1.4.3 Testing mAs accuracy on page 124
   - Reproducability - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127
   - Linearity - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127
   - Generator operator indicators - see 7.1.6 Testing generator operator indicators on page 131

8.5.13 Wireless USB host radio board

Applies to Optima XR220amx and Optima XR200amx with digital upgrade systems only.

8.5.13.1 Personnel requirements

Required persons: 1
Timing (min): 15

8.5.13.2 Preliminary requirements

8.5.13.2.1 Tools and test equipment

- Standard tool kit
- Security TORX bit

8.5.13.2.2 Consumables

- None

8.5.13.2.3 Replacement parts

Item: Wireless USB host radio board
Quantity: 1

8.5.13.2.4 Safety

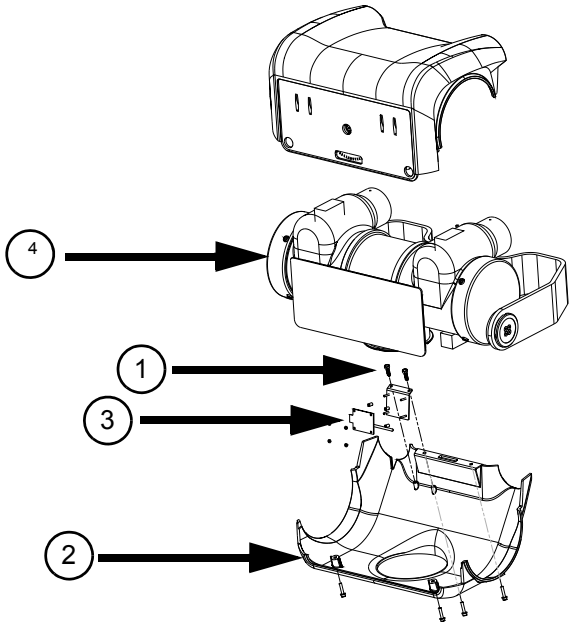
- None

8.5.13.2.5 Required conditions

- Remove the X-ray tube top cover. See 8.1.7 Tube head cover removal.

8.5.13.3 Procedure

1. See Figure 8-74. At the rear of the lower cover (Item 2), remove the two mounting screws (Item 1).



Item	Description
1	Mounting screws
2	Lower tube cover
3	Wireless USB host radio board
4	X-ray tube

Figure 8-74 Wireless USB host radio board

2. Remove the Wireless USB Host Radio Board assembly from the lower cover.
3. Unplug the USB cable from the circuit board (Item 3).
4. Remove the 4 nuts and replace the old circuit board with the new circuit board. Install and tighten the nuts.
5. Plug the USB cable into the circuit board.
6. Install the assembly into the lower cover.
7. Install the tube upper cover

8.5.13.4 Finalization

None

8.5.14 Whip antenna

Applies to Optima XR220amx and Optima XR200amx with digital upgrade systems only.

8.5.14.1 Personnel requirements

Required persons: 1

Timing (min): 15

8.5.14.2 Preliminary requirements

8.5.14.2.1 Tools and test equipment

- Standard tool kit

8.5.14.2.2 Consumables

- None

8.5.14.2.3 Replacement parts

Item: Whip antenna
Quantity: 1

8.5.14.2.4 Safety

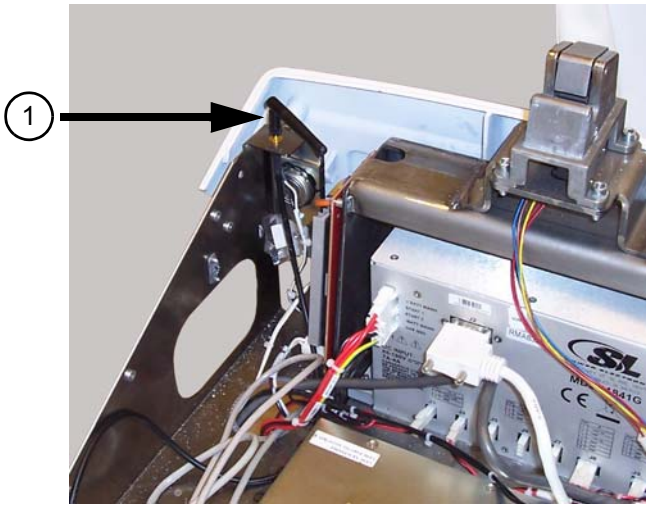
- None

8.5.14.2.5 Required conditions

- Remove the side covers and the top cover. See 8.1.2 Top cover removal.

8.5.14.3 Procedure

1. See Figure 8-75. Unscrew the whip antenna from the chassis-mounted connector.



Item	Description
1	Whip antenna

Figure 8-75 Whip antenna

2. Install the new whip antenna.
3. Install the top cover.
4. Install the side covers.

8.5.14.4 Finalization

None

8.5.15 Digital detector

Applies to Optima XR220amx and Optima XR200amx with digital upgrade systems only.

8.5.15.1 Personnel requirements

Required persons: 1

Timing (hr): 8

8.5.15.2 Preliminary requirements

8.5.15.2.1 Tools and test equipment

- Standard tool kit

8.5.15.2.2 Consumables

- None

8.5.15.2.3 Replacement parts

Item: Digital detector

Quantity: 1

8.5.15.2.4 Safety

- None

8.5.15.2.5 Required conditions

- None

8.5.15.3 Procedure

1. Check the detector battery charge level and recharge if needed.
2. Download detector firmware. See Section 3.5 Detector firmware download.
3. Perform detector registration. See the Optima XR220amx Operator Manual, Set Preferences=>System=>Wireless Detector=>Detector Registration. Leave the tether connected after completing registration.

8.5.15.4 Finalization

1. With the tether still connected, create an exam, perform an X-ray exposure and confirm that an image is created.
2. Disconnect the tether from the detector and the system. Install the battery in the detector.
3. Create an exam, perform an X-ray exposure and confirm that an image is created.
4. Remove the detector battery and replace it with the tether. Connect the other end of the tether to the system.
5. With the tether still connected, perform detector calibration. See Section 5.4 Detector calibration on page 91.

6. With the tether still connected, perform QAP. Refer to the Installation Manual, Chapter 6 - Detector checks and QAP.

8.5.16 Detector bin park switch

Applies to Optima XR220amx and Optima XR200amx with digital upgrade systems only.

8.5.16.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.16.2 Preliminary requirements

8.5.16.2.1 Tools and test equipment

- Standard tool kit

8.5.16.2.2 Consumables

- None

8.5.16.2.3 Replacement parts

Item: Detector bin park switch

Quantity: 1

8.5.16.2.4 Safety

- None

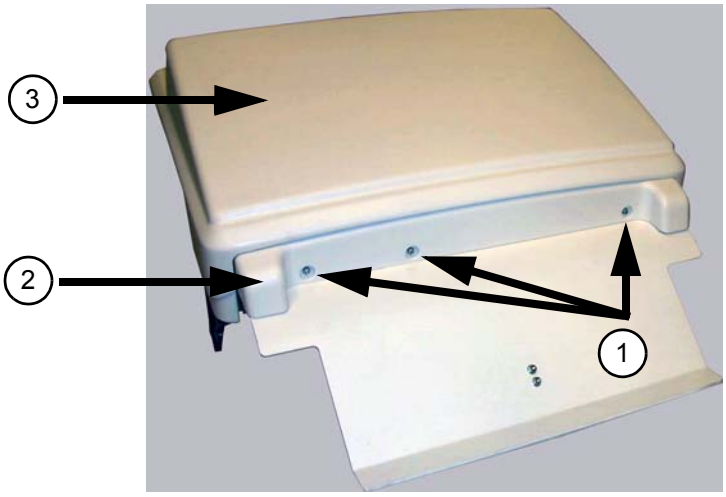
8.5.16.2.5 Required conditions

- Remove the side covers and the rear bin. See 8.1.5 Rear bin removal.

8.5.16.3 Procedure

1. See Figure 8-76. Remove the 3 mounting screws (Item1) and access cover (Item 2) from the

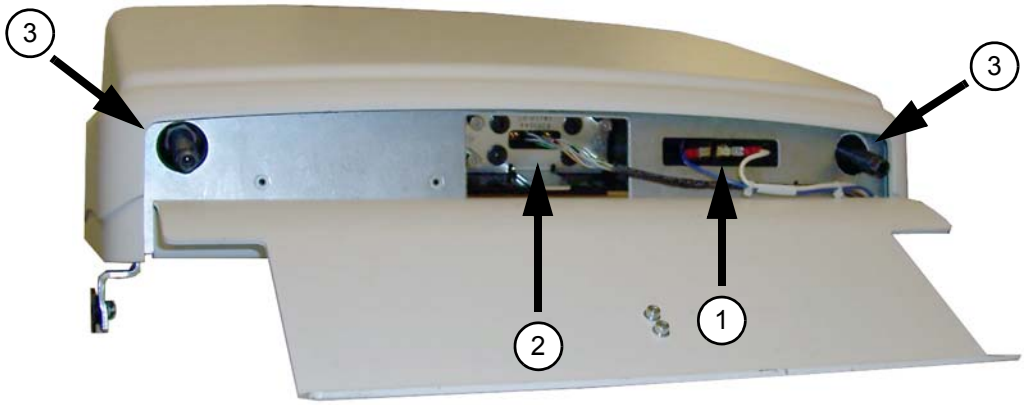
bottom of the rear bin (Item 3).



Item	Description
1	Mounting screws (3 used)
2	Access cover
3	Rear bin

Figure 8-76 Rear bin (bottom view)

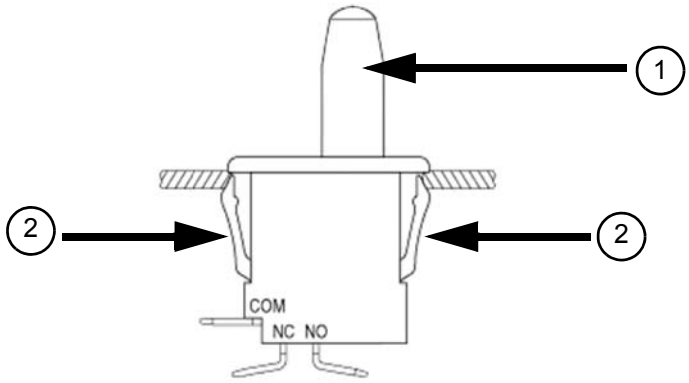
2. See Figure 8-76. Remove the two wires from the park switch (Item 1).



Item	Description
1	Detector park switch
2	Detector charge connector assembly
3	Shock absorber (2 used)

Figure 8-77 Rear bin (bottom view)

3. Use a screwdriver to depress the mounting tabs (Item 2) on the side of the switch (Item 1) while gently pushing on the switch body. Alternate from one side of the switch to the other until the switch can be removed from inside the rear bin.



Item	Description
1	Detector park switch
2	Mounting tabs

Figure 8-78 Rear bin (bottom view)

4. Install the new switch by placing it in the recess and pushing downward until it snaps into place.
5. Connect the two wires to the COM (common) and NC (normally closed) terminals of the switch.
6. Install the access cover.
7. Install the rear bin.
8. Install the sides covers

8.5.16.4 Finalization

Perform the following functional checks:

- Drive (speed limited in tethered mode) - see Table 2-2 Functional checks on page 35

8.5.17 Detector charge cable assembly

Applies to Optima XR220amx and Optima XR200amx with digital upgrade systems only.

8.5.17.1 Personnel requirements

Required persons: 1
Timing (min): 30

8.5.17.2 Preliminary requirements

8.5.17.2.1 Tools and test equipment

- Standard tool kit

8.5.17.2.2 Consumables

- None

8.5.17.2.3 Replacement parts

Item: Detector charge cable assembly

Quantity: 1

8.5.17.2.4 Safety

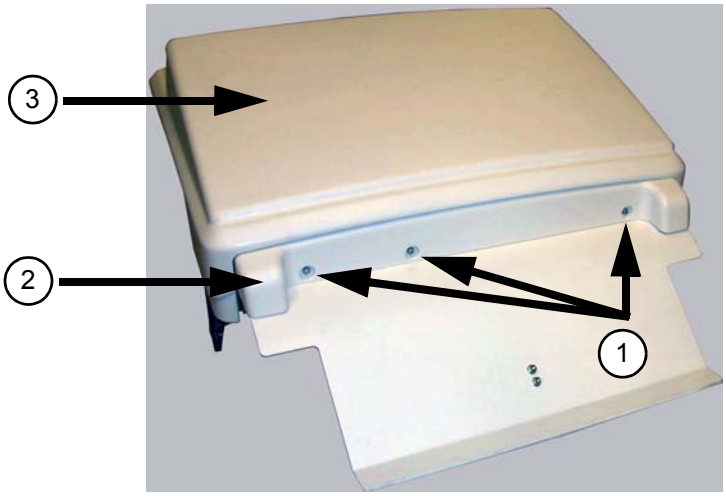
- None

8.5.17.2.5 Required conditions

- Remove the side covers and the rear bin. See 8.1.5 Rear bin removal.

8.5.17.3 Procedure

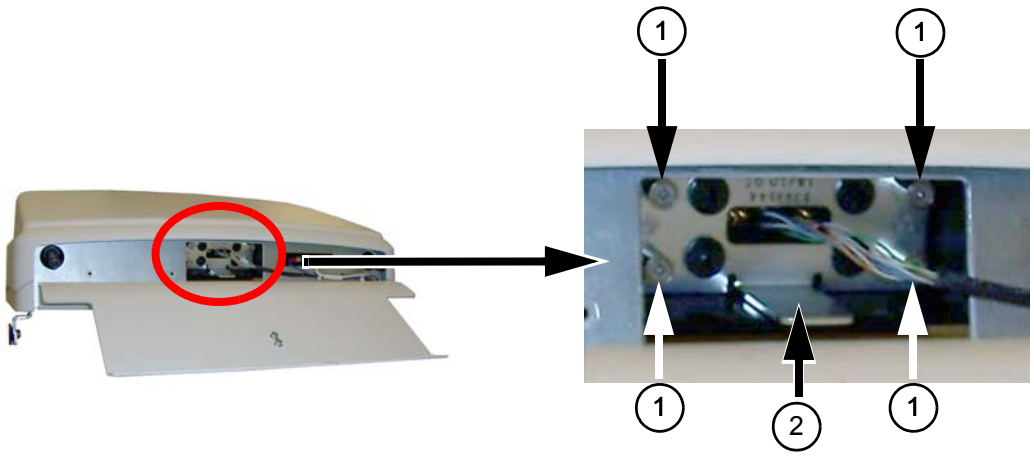
1. See Figure 8-79. Remove the 3 mounting screws (Item1) and access cover (Item 2) from the bottom of the rear bin (Item 3).



Item	Description
1	Mounting screws (3 used)
2	Access cover
3	Rear bin

Figure 8-79 Rear bin (bottom view)

2. See Figure 8-80. Loosen the four mounting screws (Item 1). Do not attempt to remove the screws as they are captive-style.



Item	Description
1	Detector charge connector assembly
2	Bracket tab

Figure 8-80 Detector charge connector assembly

3. The connector assembly is centered with two alignment pins. To remove the connector assembly, grab the bracket tab (Item 2) and pull straight back. It may be necessary to slightly rock the assembly until it releases from the alignment pins.
4. Install the new connector assembly onto the alignment pins and tighten the mounting screws.
5. Install the access cover.
6. Install the rear bin.
7. Install the sides covers

8.5.17.4 Finalization

1. Restore system to normal operation.
2. Insert an un-tethered detector into the bin (with detector battery installed).
3. Verify that when the detector is in the storage bin, the battery LED in the detector handle is lit and blinking.

8.5.18 Detector bin shock absorber

Applies to Optima XR220amx and Optima XR200amx with digital upgrade systems only.

8.5.18.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.18.2 Preliminary requirements

8.5.18.2.1 Tools and test equipment

- Standard tool kit

8.5.18.2.2 Consumables

- None

8.5.18.2.3 Replacement parts

Item: Detector bin shock absorber(s)

Quantity: 1 or 2

8.5.18.2.4 Safety

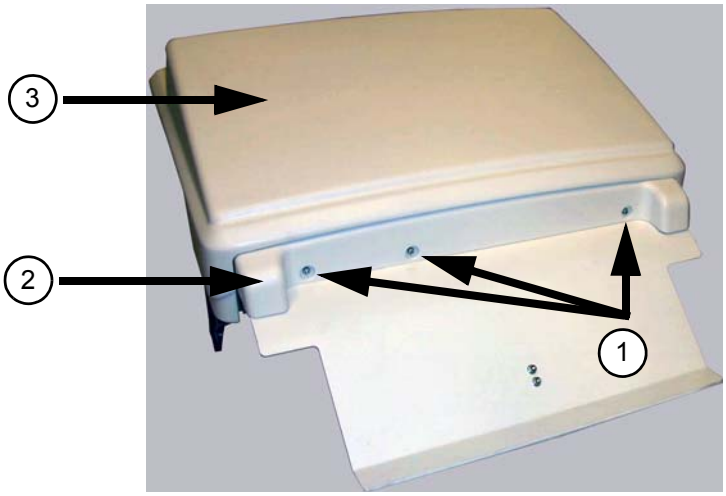
- None

8.5.18.2.5 Required conditions

- Remove the side covers and the rear bin. See 8.1.5 Rear bin removal.

8.5.18.3 Procedure

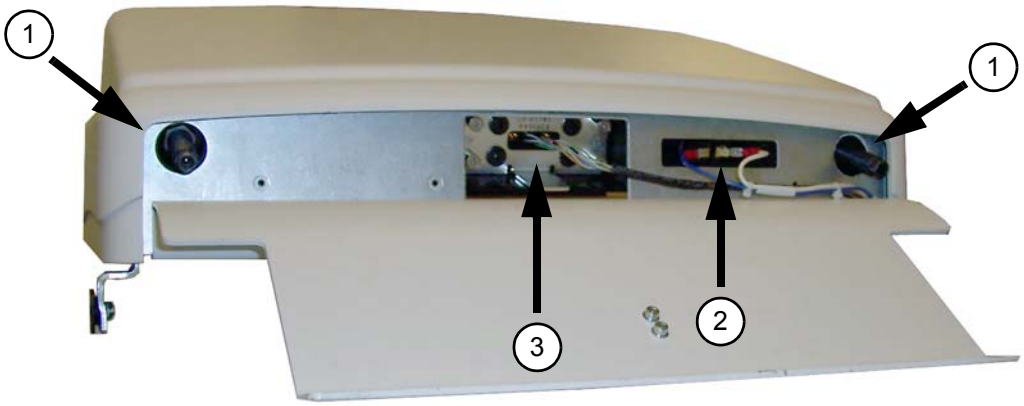
1. See Figure 8-81. Remove the 3 mounting screws (Item1) and access cover (Item 2) from the bottom of the rear bin (Item 3).



Item	Description
1	Mounting screws (3 used)
2	Access cover
3	Rear bin

Figure 8-81 Rear bin (bottom view)

2. See Figure 8-82. Loosen the locknut(s).
   Note: A 17mm 1/2" drive deep-well socket works best.
3. Use an Allen wrench to remove the shock absorber(s) (counter-clockwise rotation).



Item	Description
1	Shock absorber (2 used)
2	Detector park switch
3	Detector charge connector assembly

Figure 8-82 Rear bin (bottom view)

4. Adjust the locknut to the same approximate depth as the original shock absorber.
5. Install the new shock absorber(s).
6. Snug the 17mm locknut 1/4 turn past finger-tight.
   Note: A 17mm 1/2" drive deep-well socket works best.
7. From inside the detector bin, fully compress the shock absorber. Adjust the height of the shock absorber until the top surface of the shock absorber is flush with (or slightly below) the bottom of the detector bin.
8. Install the access cover.
9. Install the rear bin.
10. Install the sides covers

8.5.18.4 Finalization

None

8.5.19 Docking connector: detector side

Applies to Optima XR220amx and Optima XR200amx with digital upgrade systems only.

8.5.19.1 Personnel requirements

Required persons: 1

Timing (min): 20

8.5.19.2 Preliminary requirements

8.5.19.2.1 Tools and test equipment

- Standard tool kit
- ESD kit

8.5.19.2.2 Consumables

- None

8.5.19.2.3 Replacement parts

Item: Docking connector (detector side)

Quantity: 1

8.5.19.2.4 Safety

- None

8.5.19.2.5 Required conditions

- None

8.5.19.3 Procedure

1. Remove the screws (2) from the docking connector at the bottom of the wireless detector. See Figure 8-83.

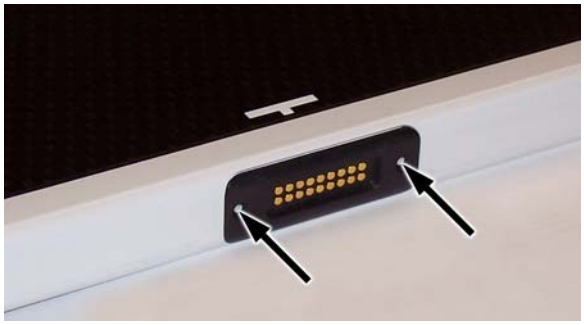


Figure 8-83 Remove detector docking connector

2. Carefully pull the connector from the detector body.
3. Disconnect the cable from the connector. See Figure 8-84.

Figure 8-84 Unplug detector docking connector

4. Connect the cable to the new connector.
5. Attach the new connector to the detector.

8.5.19.4 Finalization

1. Turn on system power.
2. Verify that when the detector is in the storage bin, the charge LED in the detector handle is lit.
3. Verify that when the detector is in the storage bin, the system recognizes the detector.
4. Perform the following functional checks:
   - Drive (speed limited in tethered mode) see Table 2-2 Functional checks on page 35

8.5.20 Beetle Djinn set of cables

The 'Beetle Djinn set of cables' is a kit that consists of all the cables that inter-connect the Djinn generator hardware assemblies.

The Djinn generator hardware assemblies are defined as:

- Main Auxiliary Module (15kW)
- Optional Auxiliary Module (30kW) - this is a purchased option
- HV Tank
- Power Module (mounted to the HV Tank)

Other control cables that interface the Djinn generator hardware to the rest of the system are not included in this cable kit.

8.5.20.1 Personnel requirements

Required persons: 1

Timing (min): 6 hrs

8.5.20.2 Preliminary requirements

8.5.20.2.1 Tools and test equipment

- Standard tool kit

8.5.20.2.2 Consumables

- Cable ties

8.5.20.2.3 Replacement parts

Item: Beetle Djinn set of cables

Quantity: 1

8.5.20.2.4 Safety

- None

8.5.20.2.5 Required conditions

- Remove the side covers, front covers and rear bin. See 8.1.3 Front cover removal and 8.1.5 Rear bin removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.20.3 Procedure

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Some cables are accessed/replaced from *outside* the chassis; some from *inside* the chassis. Refer to Table 8-1 for a summary of the cables and the associated generator hardware they are connected to.

Table 8-1 Beetle Djinn set of cables

Item	Description
The cables listed below are accessed from ***outside*** the Thorax assembly.The side covers and front covers must be removed to provide access.	
-	Shielded cable assy, Main Aux Module (15kW) to Power Module
-	Cable, Power Module Filament Board to Main Aux Module (15kW)
The cables listed below are accessed from ***inside*** the Thorax assembly.The side covers and rear bin assembly must be removed to provide access. If present, the Optional Power Module (30kW) must be unbolted and moved aside to access the connections on the rear of the HV Tank.	
-	Cable, Power Module Filament Board to HV Tank
-	Flat ribbon cable, Power Module Control Board to HV Tank
-	Cable, Power Module to HV Tank (very short)
-	Cable, Power Module to HV Tank (short)
-	Ground cable, Main Aux Module (15kW) to Opt Aux Module (30kW) - UNUSED
-	Ground cable, Main Aux Module (15kW) to Power Module - UNUSED
-	Ground cable, Power Module to HV Tank - UNUSED

2. Replace each cable individually, one at a time.
3. For each cable:
   a. If present, remove cable clamps and/or cut cable ties that are constraining the cable.
   b. Disconnect each end of the cable.
   c. Remove the cable and set aside (do not mix old cables with new cables).
   d. Install the new cable.
4. When all the cables have been replaced, re-install any cable clamps and replace any cable ties that were previously removed.
5. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
6. Install the front covers.
7. Install the rear bin.
8. Install the side covers.

8.5.20.4 Finalization

1. Perform the following calibrations:
   - Filament - see 5.3.1 Setting filament drive level on page 90

2. Perform the following HHS checks:
   - kV accuracy - see 7.1.4.2 Testing kVp accuracy on page 122
   - mAs Accuracy - see 7.1.4.3 Testing mAs accuracy on page 124
   - Reproducability - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127
   - Linearity - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127

8.5.21 Djinn 15kW Auxiliary module

8.5.21.1 Personnel requirements

Required persons: 1

Timing (min): 6 hrs

8.5.21.2 Preliminary requirements

8.5.21.2.1 Tools and test equipment

- Standard tool kit

8.5.21.2.2 Consumables

- None

8.5.21.2.3 Replacement parts

Item: Djinn auxiliary module 15kW

Quantity: 1

8.5.21.2.4 Safety

- None

8.5.21.2.5 Required conditions

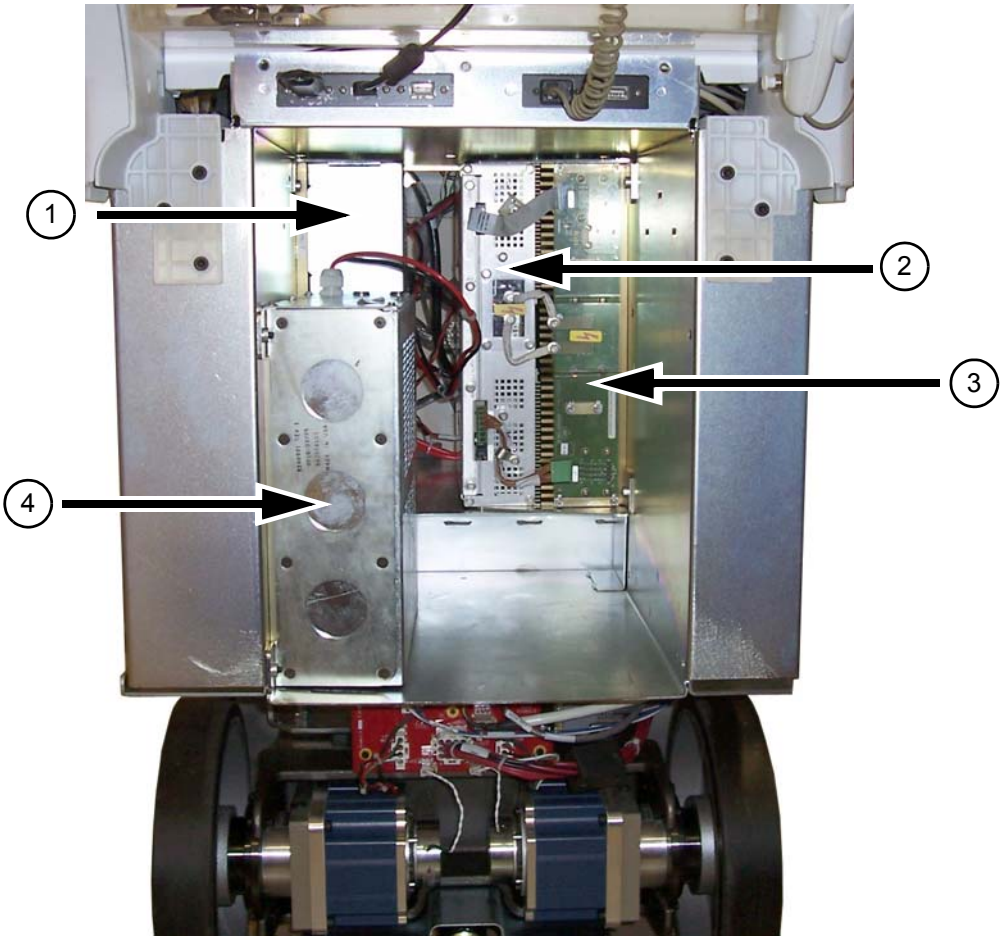
- Remove the side covers and rear bin. See 8.1.5 Rear bin removal.
- Remove the front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.21.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Locate the aux module 15kW. See Figure 8-85.

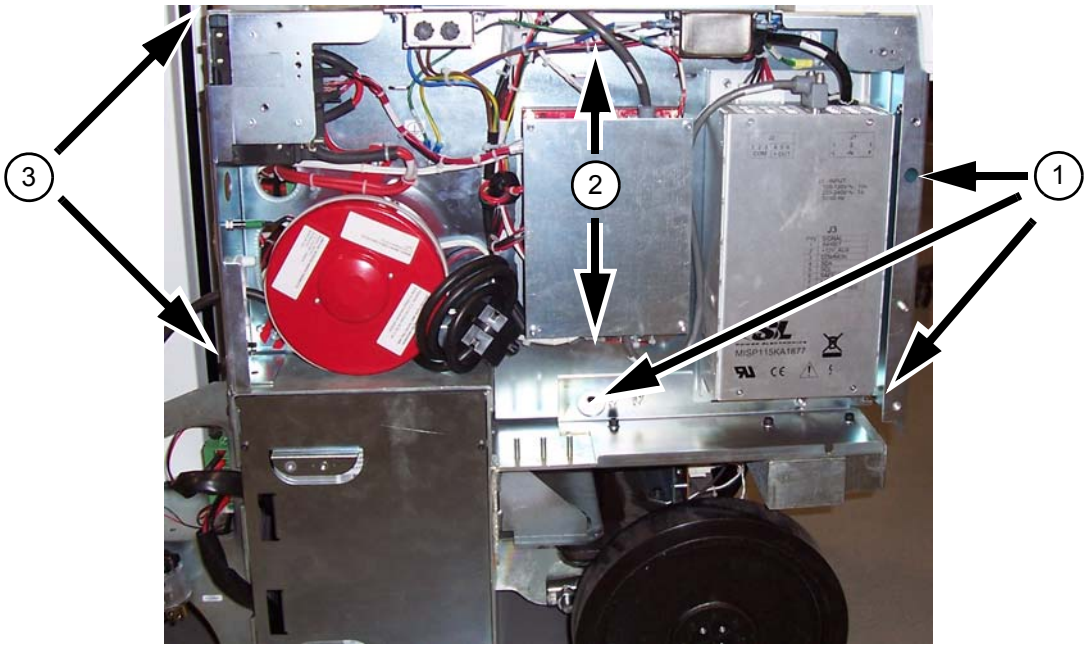


Item	Description
1	Aux module 15kW
2	Power module
3	HV Tank
4	Aux module 30kW

Figure 8-85 Djinn generator module locations

2. Locate the aux module 30kW (if present). See Figure 8-85.
   The aux module 30kW must be removed before the aux module 15kW can be removed.
3. Disconnect the cable (red/black wires) from the rear of the aux module 15kW.

4. Remove the aux module 30kW (4 screws - see Figure 8-86) and set aside.
5. Disconnect all cables (5 or 6 connections, depending on configuration) from the rear of the module.
6. Remove the old module (4 screws - 2 on the front, 2 on the back). See Figure 8-86. Due to space limitations, the module must be removed through the rear of the unit.



Item	Description
1	Aux module 30kW mounting screws (3 on front side of panel)
2	Aux module 15kW mounting screws (2 on front side of panel)
3	Aux module 15kW mounting screws (2 on rear side of panel)

Figure 8-86 Aux module 15kW mounting screws

7. Install the new module.
8. Connect all cables to the module.
9. Install the aux module 30kW in the chassis.
10. Connect the cable (red/black wires) to the rear of the aux module 15kW.
11. Install the rear bin.
12. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
13. Install the front covers.
14. Install the side covers.

8.5.21.4 Finalization

1. The system will report a `BDM Mismatch` error detected with 2 selections:
   RESTORE and CANCEL
   Make sure you select RESTORE to have the Board Data Module upload the correct contents to the Djinn generator. Failure to do so will result in erratic or failed system functionality. Recovery requires a complete firmware download and system calibrations.
2. Perform the following calibrations:

- Filament - see 5.3.1 Setting filament drive level on page 90

3. Perform the following HHS checks:
   - kV accuracy - see 7.1.4.2 Testing kVp accuracy on page 122
   - mAs Accuracy - see 7.1.4.3 Testing mAs accuracy on page 124
   - Reproducability - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127
   - Linearity - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127

8.5.22 Djinn power module

8.5.22.1 Personnel requirements

Required persons: 1

Timing (min): 6 hrs

8.5.22.2 Preliminary requirements

8.5.22.2.1 Tools and test equipment

- Standard tool kit

8.5.22.2.2 Consumables

- Silicone oil (GE P/N LNR8733)

8.5.22.2.3 Replacement parts

Item: Djinn power module

Quantity: 1

8.5.22.2.4 Safety

- None

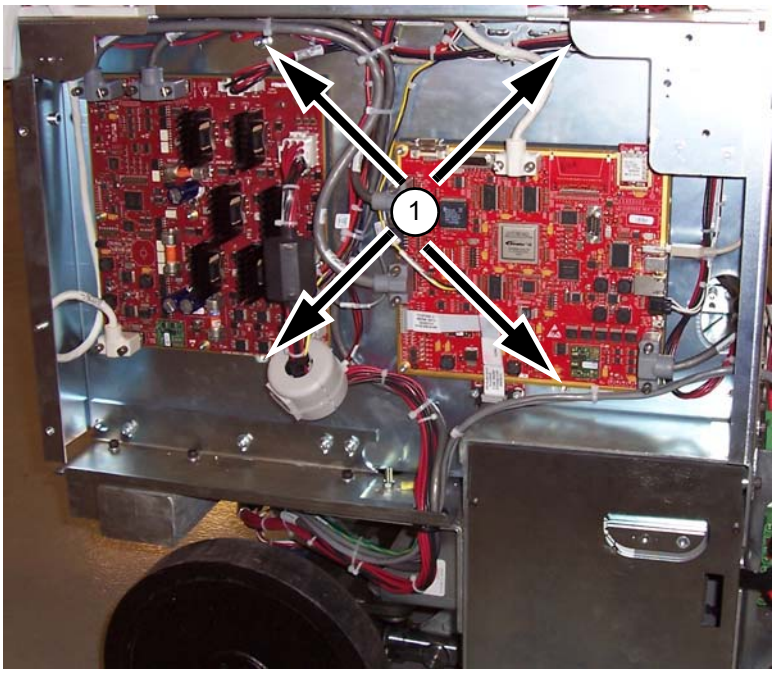
8.5.22.2.5 Required conditions

- Remove the side covers and the rear bin. See 8.1.5 Rear bin removal.
- Remove the front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.22.3 Procedure

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Locate the power module / HV tank assembly. See Figure 8-85.
   Note that the power module and HV tank are on a mounting bracket that must be removed as an assembly.
   Due to space limitations, the assembly must be removed through the rear of the unit.
2. Disconnect all cables from the front and rear of the power module / HV tank assembly. (To remove the HV cables, the set screws (Figure 8-18) in the tightening rings must be loosened.)
3. Remove the power module / HV tank assembly (4 screws). See Figure 8-87.



Item	Description
1	Mounting screws for power module / HV tank assembly

Figure 8-87 Power module / HV tank mounting screws

4. Remove the power module from the assembly (16 screws).
5. Disconnect the cables between the power module and HV tank (4 cables).
6. Mount the new power module in the assembly.
7. Reconnect the cables between the power module and HV tank.

8. Install the assembly in the chassis.

Note: HV cables must be lubricated with silicone **oil** (GE P/N LNR8733) before insertion into the HV tank cable wells. See Figure 8-88.

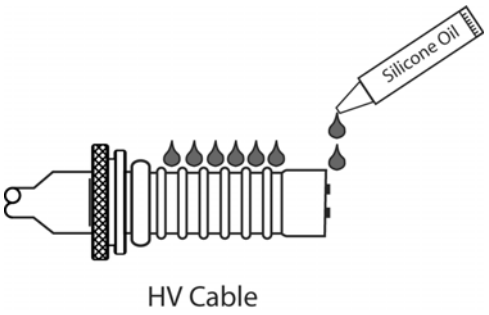


Figure 8-88 Lubricate HV cables

9. Connect all cables to the assembly.
   (After installing the HV cables, tighten the set screws in the HV cable tightening rings.)
10. Install the rear bin.
11. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
12. Install the front covers.
13. Install the side covers.

8.5.22.4 Finalization

1. The system will report a `BDM Mismatch` error detected with 2 selections:
   RESTORE and CANCEL
   Make sure you select RESTORE to have the Board Data Module upload the correct contents to the Djinn generator. Failure to do so will result in erratic or failed system functionality. Recovery requires a complete firmware download and system calibrations.
2. Perform the following calibrations:
   - Filament - see 5.3.1 Setting filament drive level on page 90
3. Perform the following HHS checks:
   - kV accuracy - see 7.1.4.2 Testing kVp accuracy on page 122
   - mAs Accuracy - see 7.1.4.3 Testing mAs accuracy on page 124
   - Reproducability - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127
   - Linearity - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127

8.5.23 Djinn HV tank

8.5.23.1 Personnel requirements

Required persons: 1

Timing (min): 6 hrs

8.5.23.2 Preliminary requirements

8.5.23.2.1 Tools and test equipment

- Standard tool kit

8.5.23.2.2 Consumables

- Silicone oil (GE P/N LNR8733)

8.5.23.2.3 Replacement parts

Item: Djinn HV Tank

Quantity: 1

8.5.23.2.4 Safety

- None

8.5.23.2.5 Required conditions

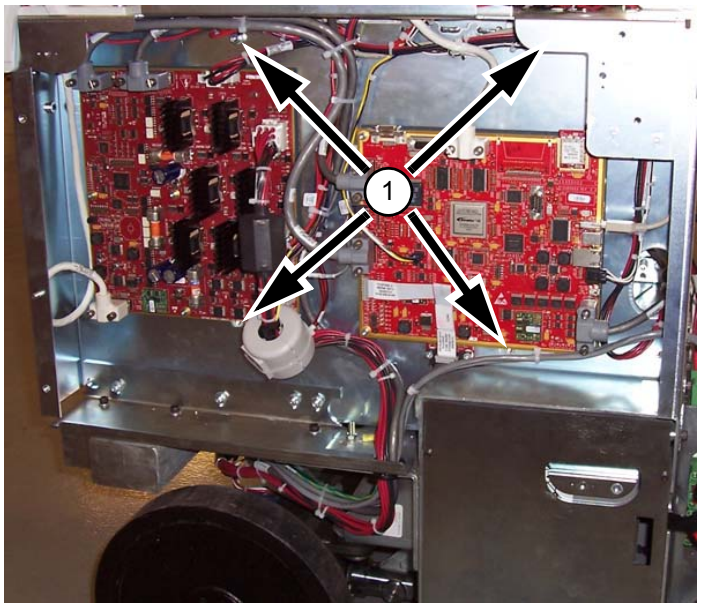
- Remove the side covers and the rear bin. See 8.1.5 Rear bin removal.
- Remove the front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.23.3 Procedure

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Locate the power module / HV tank assembly. See Figure 8-85.
   Note that the power module and HV tank are on a mounting bracket that must be removed as an assembly.
2. Disconnect all cables from the front and rear of the power module / HV tank assembly. (To remove the HV cables, the set screws (Figure 8-18) in the tightening rings must be loosened.)

3. Remove the power module / HV tank assembly (4 screws). See Figure 8-89. Due to space limitations, the module must be removed from the rear of the unit.



Item	Description
1	Mounting screws for power module / HV tank assembly

Figure 8-89 Power module / HV tank mounting screws

4. Remove the HV tank module from the assembly (8 screws).
5. Disconnect the cables between the power module and HV tank (4 cables).
6. Mount the new HV tank module in the assembly.
7. Reconnect the cables between the power module and HV tank.
8. Install the assembly in the chassis.

Note: HV cables must be lubricated with silicone oil (GE P/N LNR8733) before insertion into the HV tank cable wells. See Figure 8-90.

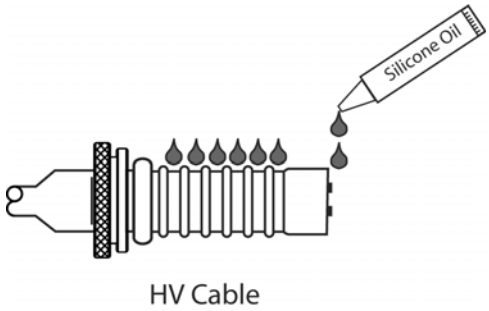


Figure 8-90 Lubricate HV cables

9. Connect all cables to the assembly.
   (After installing the HV cables, tighten the set screws in the HV cable tightening rings.)
10. Install the rear bin.

11. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
12. Install the front covers.
13. Install the side covers.

8.5.23.4 Finalization

1. The system will report a `BDM Mismatch` error detected with 2 selections:
   RESTORE and CANCEL
   Make sure you select RESTORE to have the Board Data Module upload the correct contents to the Djinn generator. Failure to do so will result in erratic or failed system functionality. Recovery requires a complete firmware download and system calibrations.
2. Perform the following calibrations:
   - Filament - see 5.3.1 Setting filament drive level on page 90
3. Perform the following HHS checks:
   - kV accuracy - see 7.1.4.2 Testing kVp accuracy on page 122
   - mAs Accuracy - see 7.1.4.3 Testing mAs accuracy on page 124
   - Reproducability - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127
   - Linearity - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127

8.5.24 Djinn 30kW auxiliary module

8.5.24.1 Personnel requirements

Required persons: 1
Timing (min): 30

8.5.24.2 Preliminary requirements

8.5.24.2.1 Tools and test equipment

- Standard tool kit

8.5.24.2.2 Consumables

- None

8.5.24.2.3 Replacement parts

Item: Djinn auxiliary module
Quantity: 1

8.5.24.2.4 Safety

- None

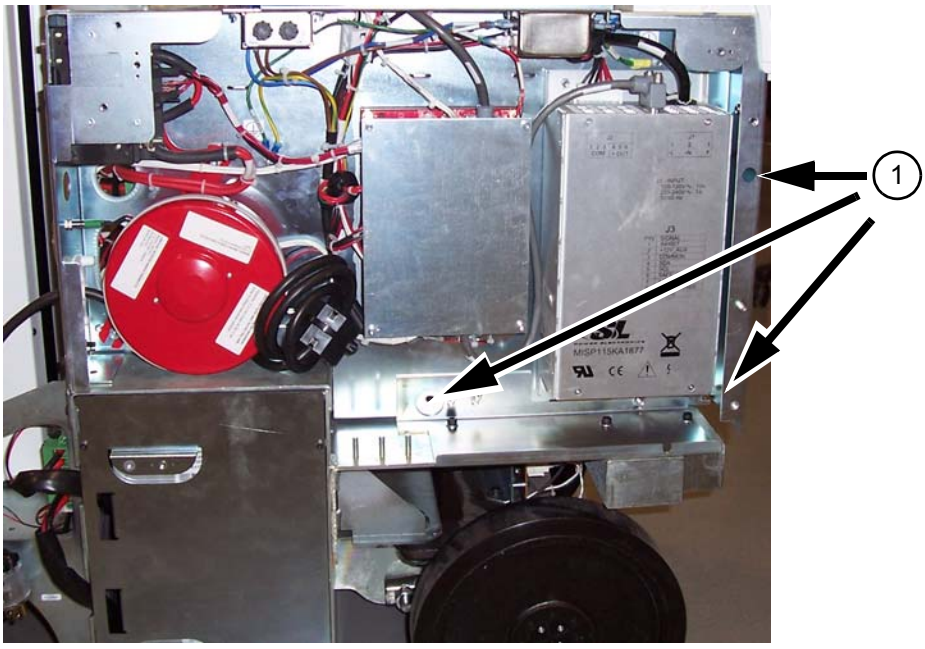
8.5.24.2.5 Required conditions

- Remove the side covers and the rear bin. See 8.1.5 Rear bin removal.
- Remove the front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.24.3 Procedure

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Locate the module. See Figure 8-85.
2. Disconnect the cable (red/black wires) from the rear of the aux module 15kW.
3. Remove the old module (3 screws). See Figure 8-91.



Item	Description
1	Aux module 30kW mounting screws (3 on front side of panel)

Figure 8-91 Aux module 30kW mounting screws

4. Install the new module.
5. Connect the cable (red/black wires) to the rear of the aux module 15kW.
6. Install the rear bin.
7. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
8. Install the front covers.
9. Install the side covers.

8.5.24.4 Finalization

Perform the following HHS checks:

- kV accuracy - see 7.1.4.2 Testing kVp accuracy on page 122
- mAs Accuracy - see 7.1.4.3 Testing mAs accuracy on page 124
- Reproducability - see 7.1.4.4 Testing reproducibility and linearity of exposure on

page 127

- Linearity - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127

8.5.25 Drive handle assembly

8.5.25.1 Personnel requirements

Required persons: 1

Timing (min): 45

8.5.25.2 Preliminary requirements

8.5.25.2.1 Tools and test equipment

- Standard tool kit

8.5.25.2.2 Consumables

- Cable ties

8.5.25.2.3 Replacement parts

Item: Drive handle assembly

Quantity: 1

8.5.25.2.4 Safety

- None

8.5.25.2.5 Required conditions

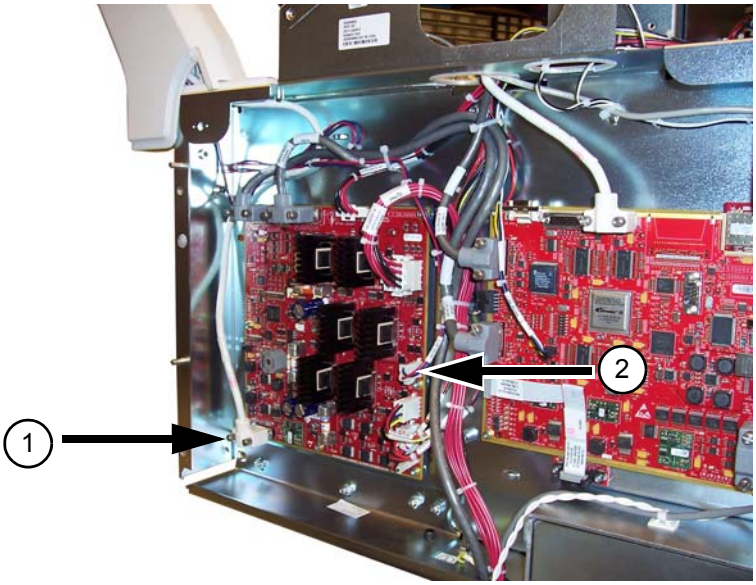
- Remove the side covers and the rear bin. See 8.1.5 Rear bin removal.
- Remove the top cover. See 8.1.2 Top cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.25.3 Procedure

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. See Figure 8-92. Disconnect the drive handle cables from the Locust board, J4 - Drive Brake (Item 2) and J7 - Drive Handle (Item 1).

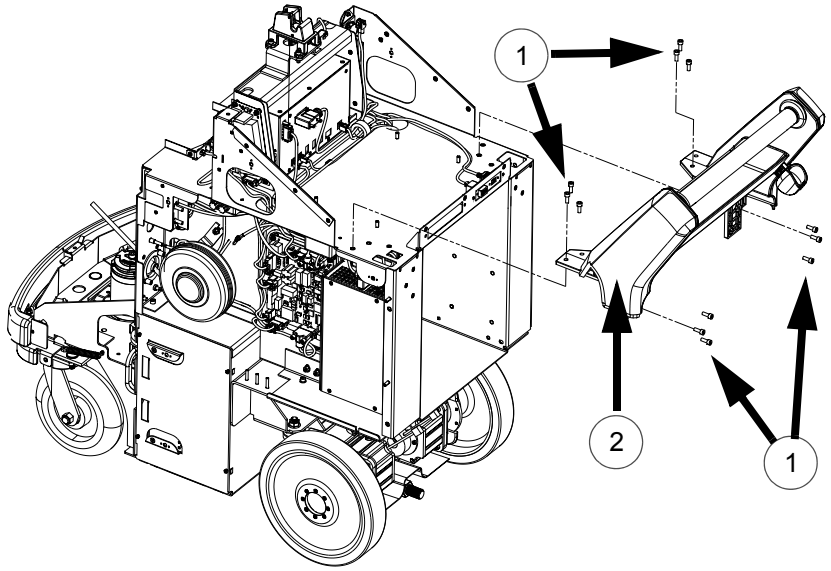


Item	Description
1	J7 - Drive Handle connector
2	J4 - Drive Brake connector
3	Cable ties

Figure 8-92 Drive handle cables

2. Cut the cable ties (Item 3) holding the cables to the chassis.

3. See Figure 8-93. Remove the 12 mounting screws (Item 1) from the drive handle (Item 2).



Item	Description
1	Mounting screws (12 used)
2	Drive handle

Figure 8-93 Drive handle assembly

4. Remove the old drive handle assembly. Guide the cable connectors through the access opening in the chassis.
5. Install the new drive handle assembly. Guide the cable connectors through the access opening in the chassis.
6. Connect the cables to the Locust board, J4 and J7.
7. Install new cable ties to hold the cables in place.
8. Install the rear bin.
9. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
10. Install the top cover.
11. Install the side covers.

8.5.25.4 Finalization

1. Perform the following calibrations:
   - Drive handle - see 5.6.1 Drive handle calibration on page 94
2. Perform the following functional checks:
   - Drive - see Drive on page 35

8.5.26 Mantis power supply

8.5.26.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.26.2 Preliminary requirements

8.5.26.2.1 Tools and test equipment

- Standard tool kit

8.5.26.2.2 Consumables

- None

8.5.26.2.3 Replacement parts

Item: Mantis power supply

Quantity: 1

8.5.26.2.4 Safety

- None

8.5.26.2.5 Required conditions

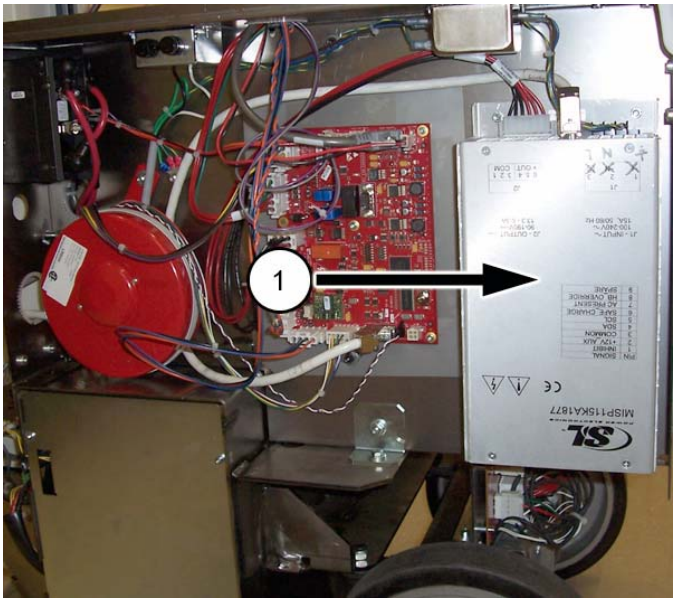
- Remove the left side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.26.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Locate the Mantis power supply. See Figure 8-94.



Item	Description
1	Mantis power supply

Figure 8-94 Mantis power supply

2. Disconnect all cables (3 connections) from the power supply.
3. Remove the old power supply (4 nuts).
4. Install the new power supply.
5. Connect all cables to the power supply.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the left side cover.

8.5.26.4 Finalization

Perform the following functional checks:

- Charging - see Charging on page 35

8.5.27 EMI filter

8.5.27.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.27.2 Preliminary requirements

8.5.27.2.1 Tools and test equipment

- Standard tool kit

8.5.27.2.2 Consumables

- None

8.5.27.2.3 Replacement parts

Item: EMI filter

Quantity: 1

8.5.27.2.4 Safety

- None

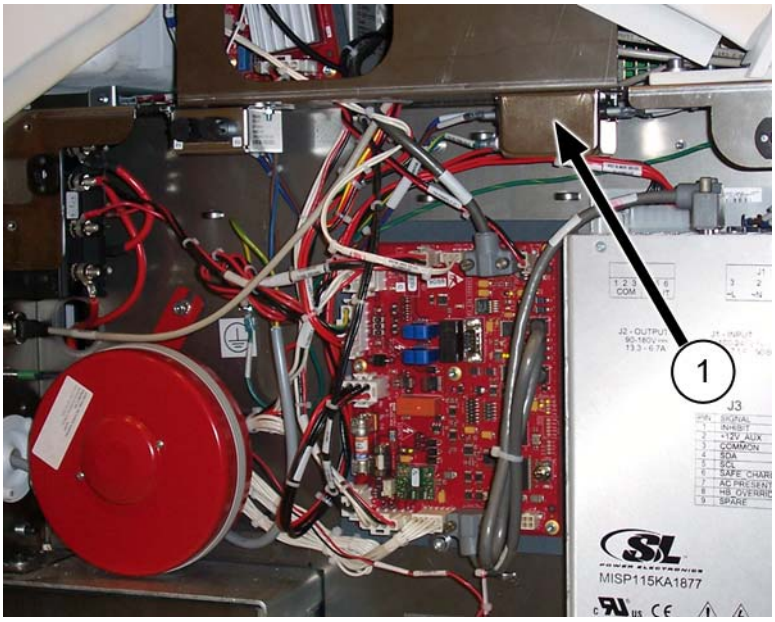
8.5.27.2.5 Required conditions

- Remove the left side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.27.3 Procedure

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Locate the EMI filter. See Figure 8-95.

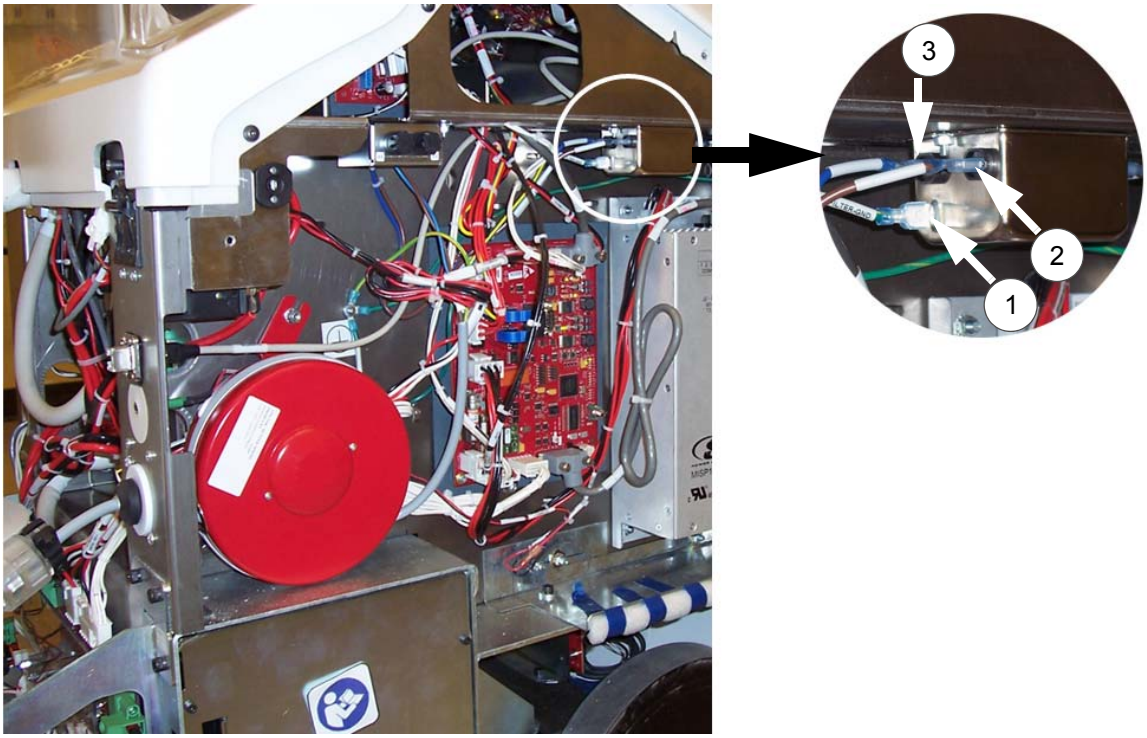


Item	Description
1	**EMI filter**

Figure 8-95 EMI filter

2. Record the color and location of the wires (5) connected to the filter.
3. Disconnect the wires from the filter.
4. Remove the old filter (2 nuts/washers).
5. Install the new filter.

6. Connect all wires to the filter. See Figure 8-96.



Item	Description
1	Ground wire (green/yellow)
2	Line wire (brown)
3	Neutral wire (blue)

Figure 8-96 EMI filter wiring

7. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
8. Install the left side cover.

8.5.27.4 Finalization

Perform the following HHS checks:

- Grounding - see 7.2.1 Performing ground resistance testing on page 131
- Leakage - see 7.2.2 Performing leakage current testing on page 141

8.5.28 LVLE2

8.5.28.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.28.2 Preliminary requirements

8.5.28.2.1 Tools and test equipment

- Standard tool kit

8.5.28.2.2 Consumables

- None

8.5.28.2.3 Replacement parts

Item: LVLE2

Quantity: 1

8.5.28.2.4 Safety

- None

8.5.28.2.5 Required conditions

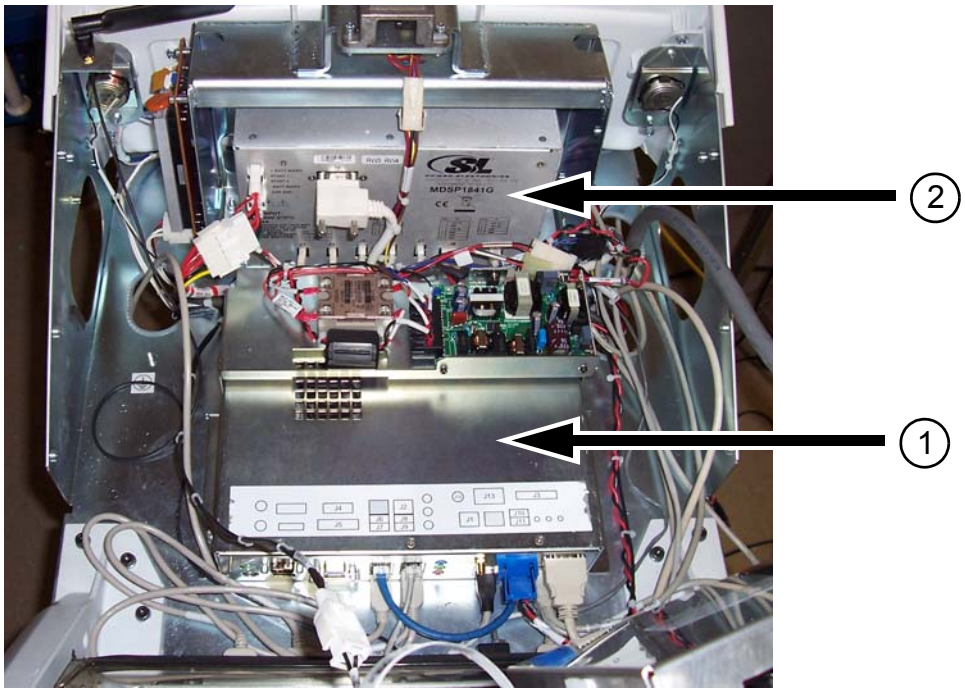
- Remove the side covers and the top cover. See 8.1.2 Top cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.28.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Locate the LVLE2 power supply. See Figure 8-97.



Item	Description
1	System PC
2	LVLE2 (Low Voltage Low Energy) power supply

Figure 8-97 Assembly identification - under top cover

2. Disconnect all cables (up to 8 connections, depending on configuration) from the LVLE2.
3. Remove the old LVLE2 (4 nuts).
4. Install the new LVLE2.
5. Connect all cables to the LVLE2.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the top cover.
8. Install the side covers.

8.5.28.4 Finalization

Perform the following functional checks:

- Charging - see Charging on page 35
- Drive - see Drive on page 35

- X-ray - see X-ray on page 36
- Light field buttons - see Collimator on page 34

8.5.29 Power cord reel

8.5.29.1 Personnel requirements

Required persons: 1

Timing (min): 60

8.5.29.2 Preliminary requirements

8.5.29.2.1 Tools and test equipment

- Standard tool kit

8.5.29.2.2 Consumables

- None

8.5.29.2.3 Replacement parts

Item: Power cord reel

Quantity: 1

8.5.29.2.4 Safety

- None

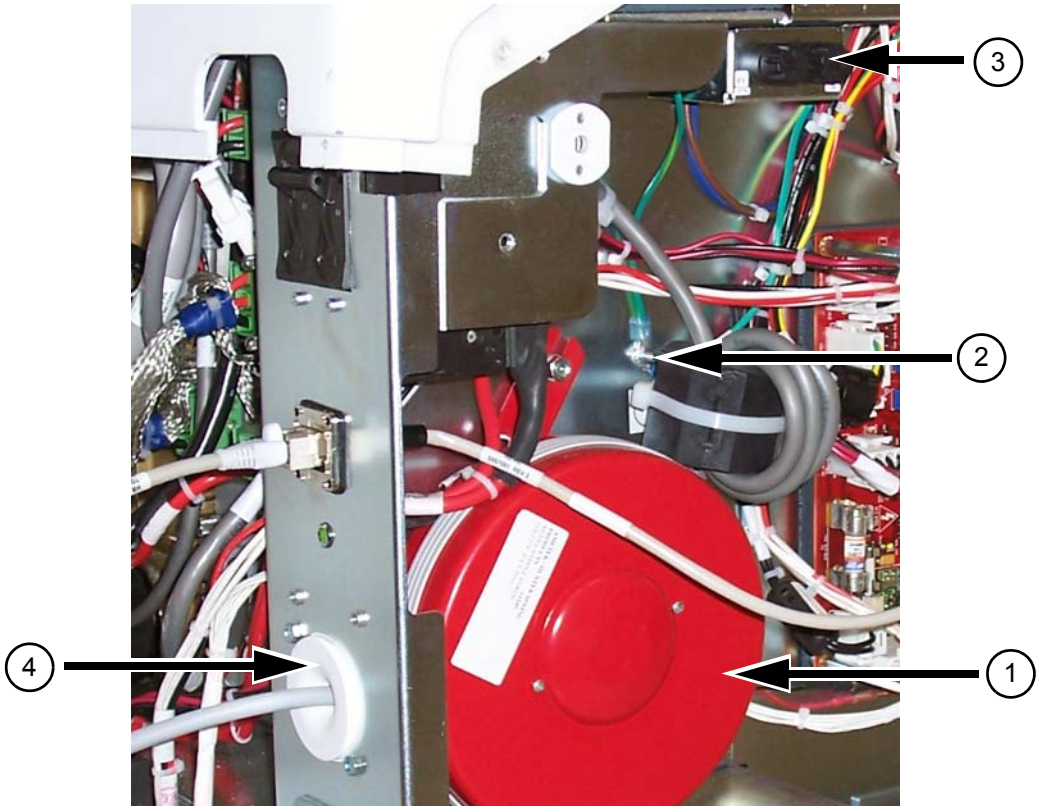
8.5.29.2.5 Required conditions

- Remove the left side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.29.3 Procedure

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
2. Locate the power cord reel, ground stud, and AC fuse assembly. See Figure 8-98.



Item	Description
1	Power cord reel
2	Chassis ground stud
3	AC fuse assembly
4	Plastic cable guide

Figure 8-98 Power cord reel location

3. Dismount the AC fuse assembly (2 nuts) from the chassis.
4. Disconnect the cord reel wires from the AC fuse assembly (note the existing connections of the wires).
5. Disconnect the cord reel ground wire from the ground stud (1 nut).
6. Dismount the plastic cable guide (2 screws).
7. Remove the cord reel (2 nuts).

8. Install the new cord reel.
9. Install the plastic cable guide.
10. Connect the ground wire to the ground stud.
11. Connect the cord reel wires to the AC fuse assembly.
12. If this is a 230VAC system, the cord replacement reel is shipped without a power plug. Perform the following steps to install a power plug:
    a. Remove the existing power plug from the old cord reel. If the power plug is damaged or missing, obtain an appropriate hospital-grade plug as dictated by local regulations.
    b. Connect the power plug to the cord reel wires as shown in Table 8-2 Power plug connections.

Table 8-2 Power plug connections

Wire color	Power plug connection
Brown (hot)	Connect to the brass terminal
Blue (neutral)	Connect to the silver terminal
Green / yellow (ground)	Connect to the green terminal

13. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
14. Install the left side cover.

8.5.29.4 Finalization

Perform the following HHS checks:

- Grounding - see 7.2.1 Performing ground resistance testing on page 131
- Leakage - see 7.2.2 Performing leakage current testing on page 141

8.5.30 AC power plug

8.5.30.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.30.2 Preliminary requirements

8.5.30.2.1 Tools and test equipment

- Standard tool kit

8.5.30.2.2 Consumables

- None

8.5.30.2.3 Replacement parts

Item: AC power plug

Quantity: 1

8.5.30.2.4 Safety

- None

8.5.30.2.5 Required conditions

- Remove the left side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.30.3 Procedure

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Remove the existing power plug (Figure 8-99) from the power cord.

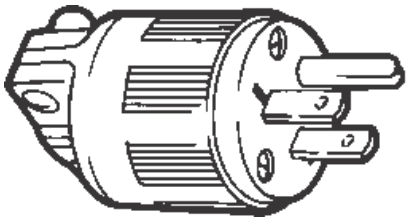


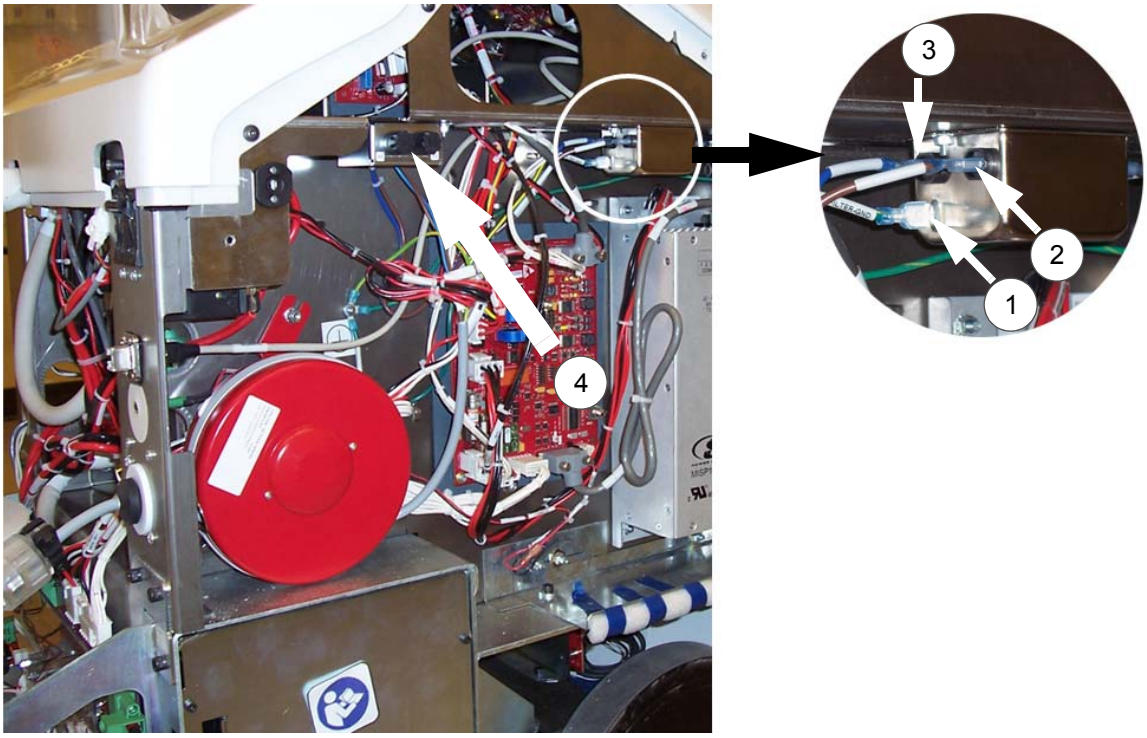
Figure 8-99 Power plug

2. Install the new power plug as shown in Table 8-3 Power plug connections.

Table 8-3 Power plug connections

Wire color	Power plug connection
Brown (line)	Connect to the brass terminal
Blue (neutral)	Connect to the silver terminal
Green / yellow (ground)	Connect to the green terminal

3. Use an ohm-meter to verify the continuity of the power connections as follows:
   a. See Figure 8-100. Each power wire will need to be pulled about 1/8" off of the terminal to allow measurement.



Item	Description
1	EMI filter - ground wire
2	EMI filter - line wire
3	EMI filter - neutral wire
4	Fuses F1 & F2

Figure 8-100 EMI filter

   b. Check continuity between the power plug ground pin and the ground terminal (Item 1 - green/yellow wire) on the EMI filter.

Note: If there is no continuity on the line (brown) wire or the neutral (blue) wire, check fuses F1 and F2 (Item 4).

   c. Check continuity between the power plug line pin and the line terminal (Item 2 - brown wire) on the EMI filter.
   d. Check continuity between the power plug neutral pin and the neutral terminal (Item 3 - blue wire) on the EMI filter.
4. Fully seat the 3 wires on the EMI filter.
5. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
6. Install the left side cover.

8.5.30.4 Finalization

Perform the following HHS checks:

- Grounding - see 7.2.1 Performing ground resistance testing on page 131
- Leakage - see 7.2.2 Performing leakage current testing on page 141

8.5.31 AC fuse holder

8.5.31.1 Personnel requirements

Required persons: 1

Timing (min): 40

8.5.31.2 Preliminary requirements

8.5.31.2.1 Tools and test equipment

- Standard tool kit

8.5.31.2.2 Consumables

- None

8.5.31.2.3 Replacement parts

Item: AC fuse holder

Quantity: As required

8.5.31.2.4 Safety

- None

8.5.31.2.5 Required conditions

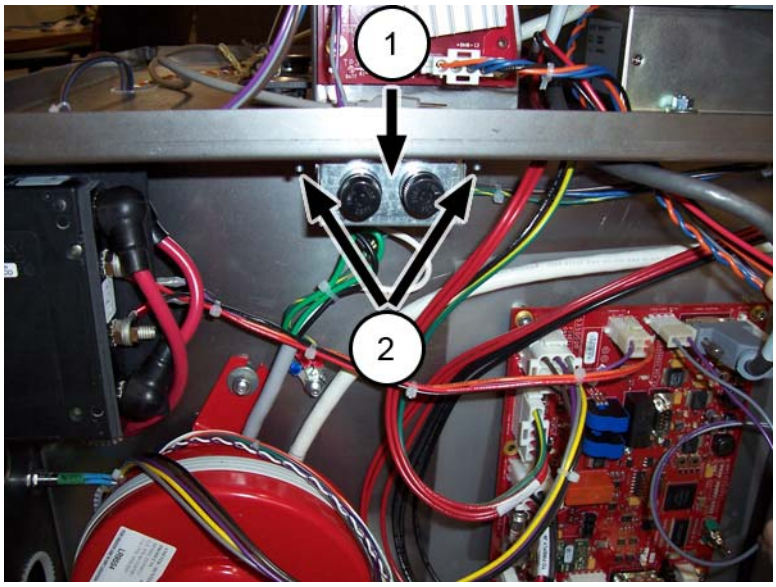
- Remove the left side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.31.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. See Figure 8-101. Locate the fuse holder assembly (Item 1).

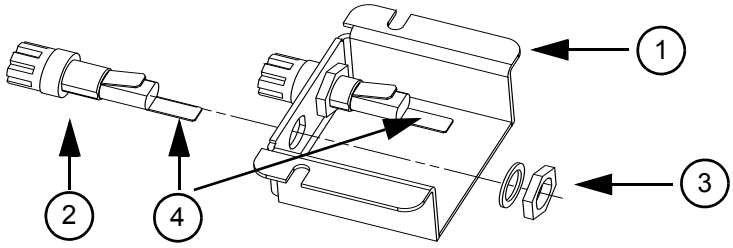


Item	Description
1	Fuse holder assembly
2	Mounting screws

Figure 8-101 AC fuse holder assembly

2. Remove the 2 screws (Item 2) and remove the fuse holder assembly from the chassis.

3. See Figure 8-102. Remove the 2 wires from the fuse holder (Item 2) that is being replaced.



Item	Description
1	Fuse holder assembly
2	Fuse holders
3	Nut and washer
4	Wires from cord reel MUST connect to these terminals

Figure 8-102 AC fuse holders

4. Remove the nut and washer (Item 3) from the rear of the fuse holder.
5. Remove the old fuse holder and replace with the new fuse holder.
6. Install the washer and nut.

WARNING

ELECTRICAL SHOCK HAZARD
Wires from the cord reel MUST be connected to the center (rear) terminals on the fuse holders.

7. Connect the 2 wires to the fuse holder. The wire coming from the cord reel MUST be connected to the center (rear) terminal (Item 4) on the fuse holder.
8. Install the fuse holder assembly on the chassis.
9. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
10. Install the left side cover.

8.5.31.4 Finalization

Perform the following HHS checks:

- Grounding - see 7.2.1 Performing ground resistance testing on page 131
- Leakage - see 7.2.2 Performing leakage current testing on page 141

8.5.32 AC fuses

8.5.32.1 Personnel requirements

Required persons: 1

Timing (min): 10

8.5.32.2 Preliminary requirements

8.5.32.2.1 Tools and test equipment

- Standard tool kit

8.5.32.2.2 Consumables

- None

8.5.32.2.3 Replacement parts

Item: AC fuse

Quantity: 1

8.5.32.2.4 Safety

- None

8.5.32.2.5 Required conditions

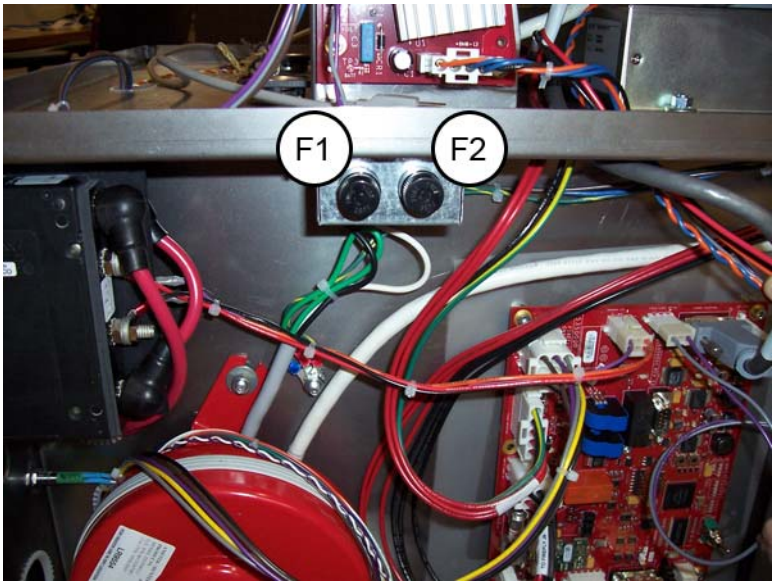
- Remove the left side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.32.3 Procedure

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Locate the AC fuses. See Figure 8-103



Item	Description
F1	AC power fuse
F2	AC power fuse

Figure 8-103 AC fuse locations

2. To remove the fuse cap from the fuse holder, push in the cap and rotate 1/4 turn counterclockwise.
3. Remove the old fuse from the cap.
4. Install the new fuse in the cap.
5. Install the fuse cap in the fuse holder.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the left side cover.

8.5.32.4 Finalization

Perform the following functional checks:

- Charging - see Charging on page 35

8.5.33 Power switch assembly

8.5.33.1 Personnel requirements

Required persons: 1

Timing (min): 20

8.5.33.2 Preliminary requirements

8.5.33.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.33.2.2 Consumables

- Loctite Super Bonder 416 Gap Filling Inst Adhesive (46-220312P1) or equivalent

8.5.33.2.3 Replacement parts

Item: Power switch assembly

Quantity: 1

8.5.33.2.4 Safety

- None

8.5.33.2.5 Required conditions

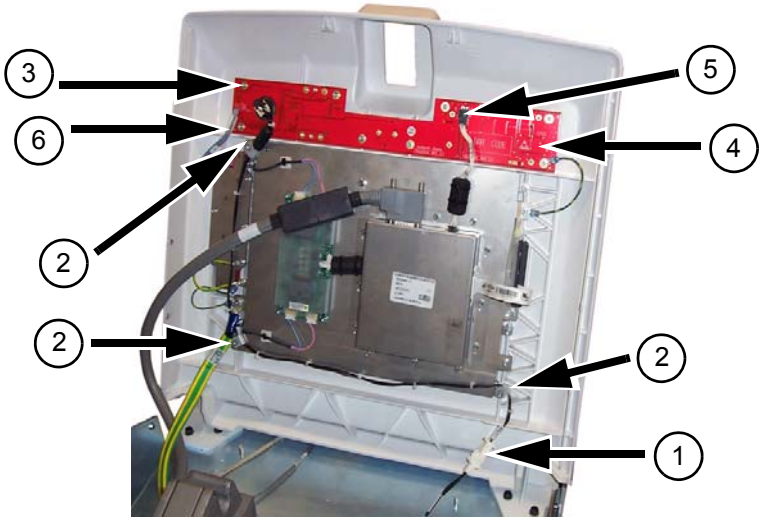
- Remove the side covers and the top cover. See 8.1.2 Top cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.33.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. See Figure 8-104. Disconnect the power switch connector (Item 1).
2. Remove the 3 cable clamps (Item 2) from the power switch wires.
3. Disconnect the drive login cable (Item 6) from the Display Overlay Board (Item 4).
4. Disconnect the overlay board to Hornet board cable (Item 5) from the Display Overlay Board.
5. Remove the mountings screws (Item 3) from the Display Overlay Board.

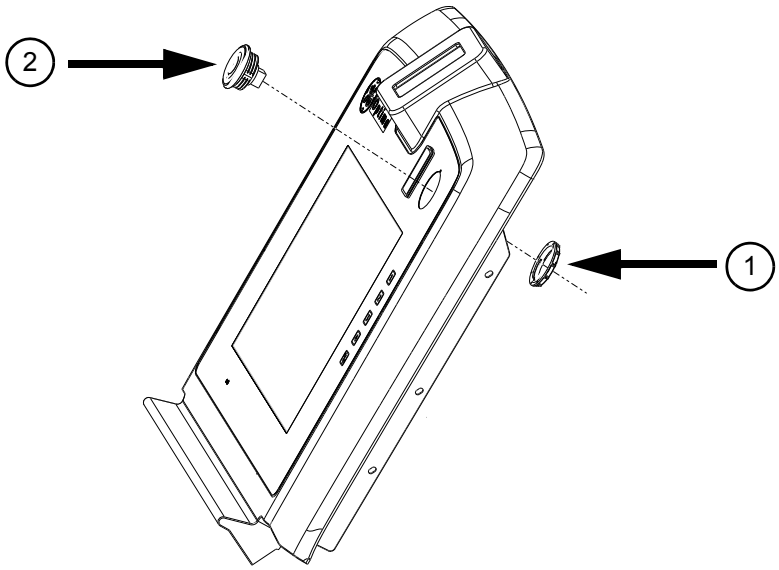


Item	Description
1	Power switch connector
2	Cable clamp (3 used)
3	Mounting screws (8 used)
4	Overlay board assembly
5	Overlay board to Hornet board cable
6	Drive login cable

Figure 8-104 Top cover components

6. Remove the Display Overlay Board and set aside.

7. See Figure 8-105. Remove the mounting nut (Item 1) from the rear of the power switch (Item 2) using a pair of side cutters. The nut is secured in place with thread locker.



Item	Description
1	Mounting nut
2	Power switch

Figure 8-105 Power switch

8. Remove the old power switch and replace with the new part. Install and secure the mounting nut using a thread locker.
9. Install the Display Overlay Board and re-connect the cables.
10. Install the cable clamps (3).
11. Connect the power switch connector.
12. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
13. Install the top cover.
14. Install the side covers.

8.5.33.4 Finalization

None

8.5.34 Overlay board assembly

8.5.34.1 Personnel requirements

Required persons: 1

Timing (min): 20

8.5.34.2 Preliminary requirements

8.5.34.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.34.2.2 Consumables

- None

8.5.34.2.3 Replacement parts

Item: Overlay board assembly

Quantity: 1

8.5.34.2.4 Safety

- None

8.5.34.2.5 Required conditions

- Remove the side covers and the top cover. See 8.1.2 Top cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

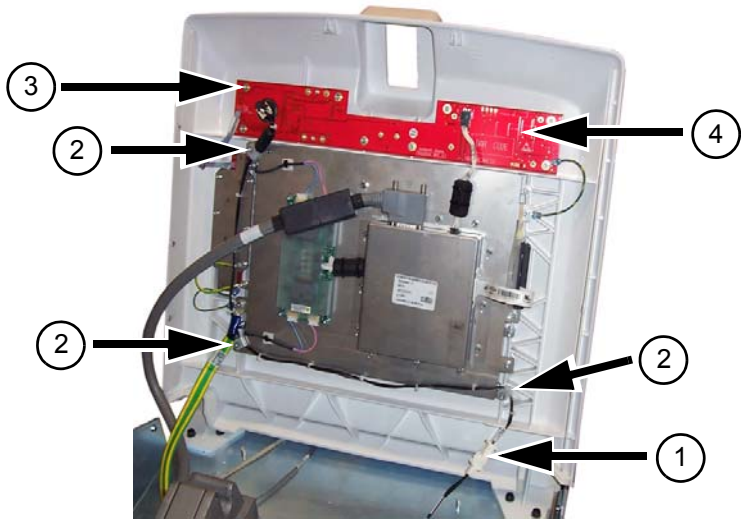
8.5.34.3 Procedure

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

This procedure has you remove the top cover from the unit.

1. See Figure 8-106. Disconnect the power switch connector (Item 1).
2. Remove the 3 cable clamps (Item 2) from the power switch wires.
3. Disconnect the cables from the Display overlay board (Item 4).
4. Remove the mountings screws (Item 3).



Item	Description
1	Power switch connector
2	Cable clamp (3 used)
3	Mounting screws (8 used)
4	Overlay board assembly

Figure 8-106 Display overlay board

5. Remove the old display overlay board and replace with the new part.
6. Install the Display Overlay Board mounting screws.
7. Install the cable clamps (3).
8. Connect the cables to the new board.
9. Connect the power switch connector.
10. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
11. Install the top cover.
12. Install the side covers.

8.5.34.4 Finalization

Perform the following functional checks:

- Charging - see Charging on page 35

8.5.35 Tube park latch assembly, switch or solenoid

8.5.35.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.35.2 Preliminary requirements

8.5.35.2.1 Tools and test equipment

- Standard tool kit
- 3/32" or 1/16" drift pin punch
- Hammer or drift pin clamping device (3" C-clamp)

8.5.35.2.2 Consumables

- None

8.5.35.2.3 Replacement parts

Item: Tube park latch assembly

Quantity: 1

Item: Tube park latch switch

Quantity: 1

Item: Tube park latch solenoid

Quantity: 1

8.5.35.2.4 Safety

- None

8.5.35.2.5 Required conditions

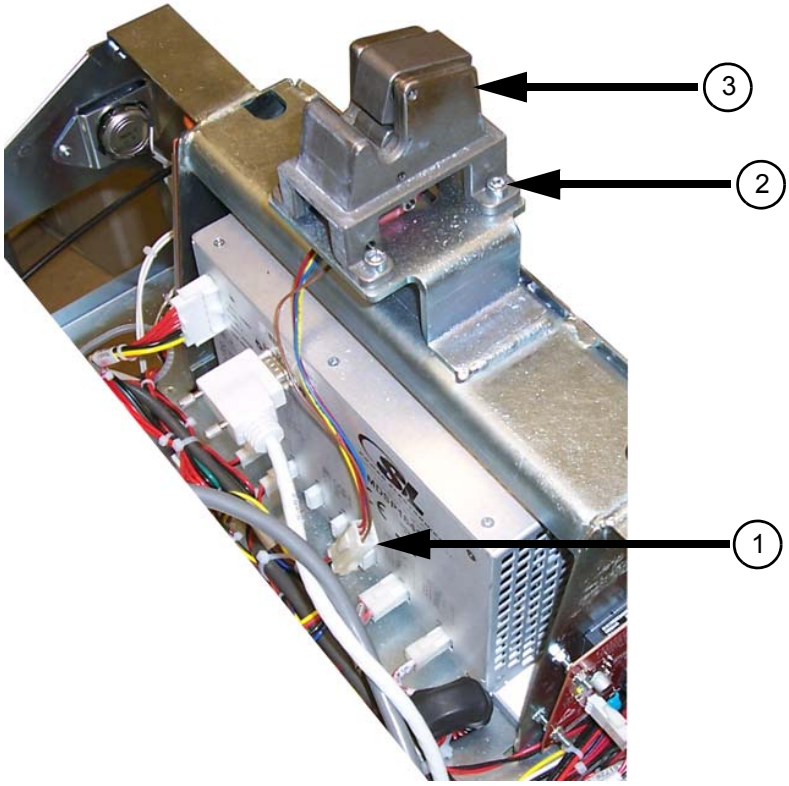
- Remove the side covers and the top cover. See 8.1.2 Top cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.35.3 Procedure

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

8.5.35.3.1 Tube park latch assembly

1. See Figure 8-107. Disconnect the wiring harness connector (Item 1).



Item	Description
1	Wiring harness connector
2	Mounting screws (4)
3	Tube park latch assembly

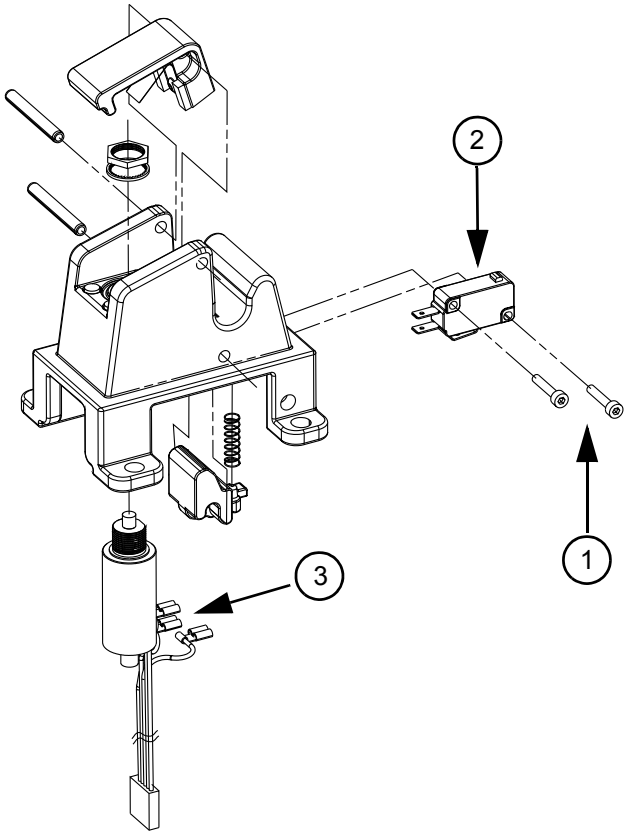
Figure 8-107 Tube park latch assembly

2. Remove the 4 mounting bolts (Item 2) from the tube park latch assembly (Item 3).
3. Replace the old assembly with the new assembly.
4. Install and tighten the mounting bolts.
5. Connect the cable harness.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the top cover.

8. Install the side covers.

8.5.35.3.2 Tube park latch switch

1. See Figure 8-108. Remove the 2 mounting screws (Item 1) from the switch (Item 2).



Item	Description
1	Mounting screws
2	Switch
3	Spade connectors (3) for switch

Figure 8-108 Tube park latch switch

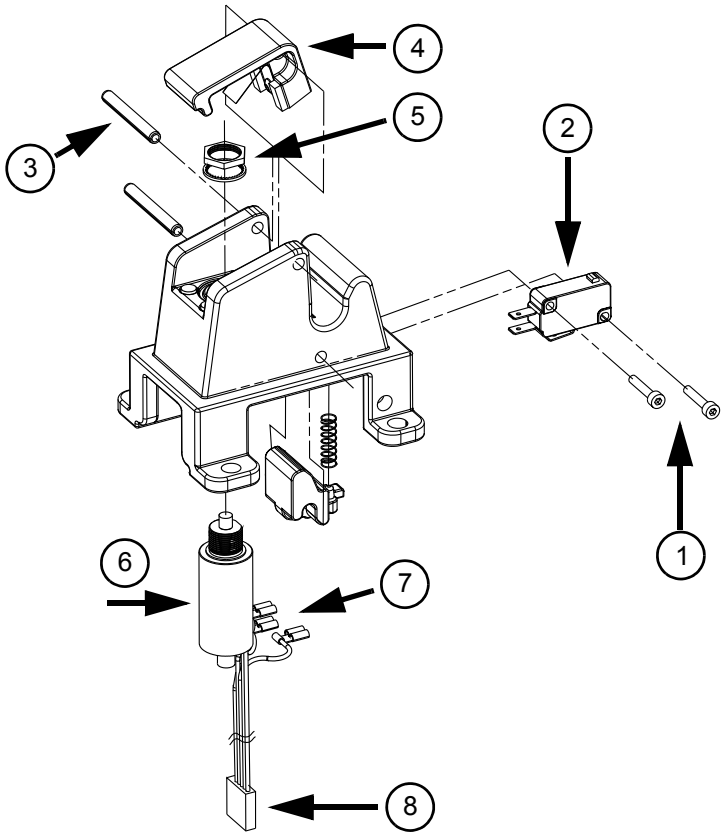
2. Record the color and location of the wires connected to the switch.
3. Remove the spade connectors (Item 3) from the switch and remove the switch from the assembly.
4. Connect the spade connectors to the new switch.
5. Install the switch into the assembly and tighten the mounting screws.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the top cover.
8. Install the side covers.

8.5.35.3.3 Tube park latch solenoid

1. Remove the park latch assembly (see 8.5.35.3.1 Tube park latch assembly on page 300).

   Note: It is recommended that you take the assembly to a sturdy work bench as the procedure can cause damage to customer surfaces.

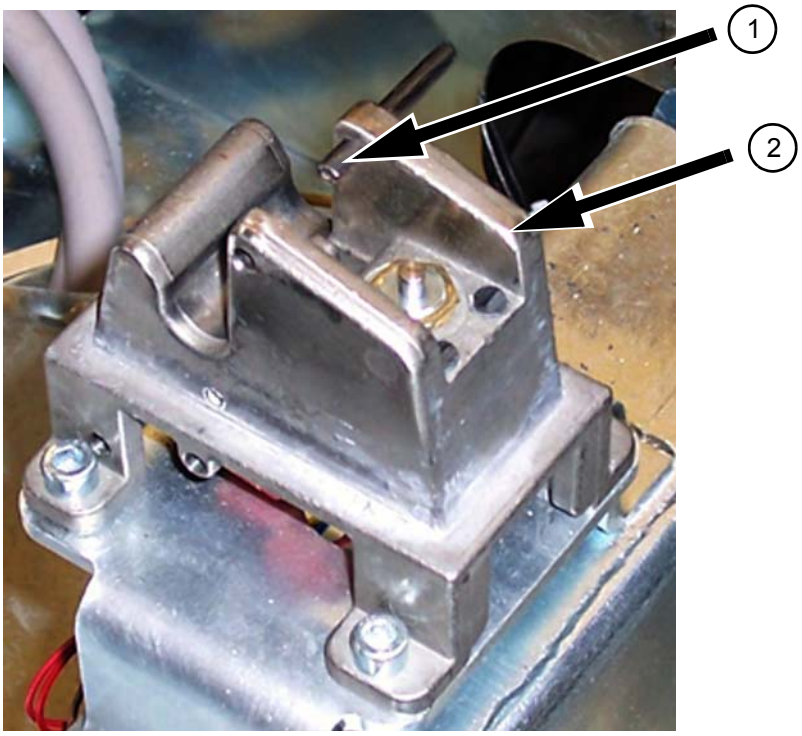
2. See Figure 8-109. Remove the 2 mounting screws (Item 1) from the switch (Item 2).



Item	Description
1	Switch mounting screws (2)
2	Switch
3	Pin
4	Latch
5	Nut and washer
6	Solenoid and wiring harness
7	Spade connectors (3) for switch
8	Wiring harness connector

Figure 8-109 Tube park latch assembly

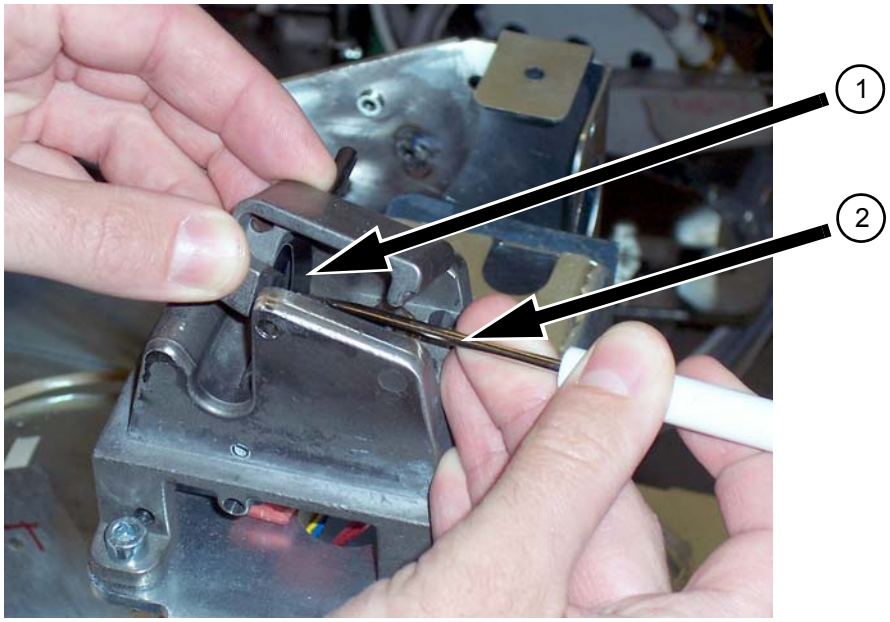
3. Remove the spade connectors (Item 6) from the switch.
4. Drive the upper pin (Item 3) out of the park latch assembly until the latch (Item 4) can be removed. About 6.5 mm (0.25 in.) of the pin will remain in the latch assembly body (see Figure 8-110, Item 1).



Item	Description
1	Latch pin (about 6.5mm [0.25 in] remains inside latch assembly body)
2	Latch assembly body

Figure 8-110 Remove latch pin and latch

5. Remove the latch (Figure 8-109, Item 4).
6. Remove the nut and washer (Figure 8-109, Item 5) from the solenoid (Figure 8-109, Item 6).
7. Record the color and location of the wires connected to the switch (Figure 8-109, Item 7).
8. Disconnect the wiring harness connector (Figure 8-109, Item 8).
9. Remove the solenoid assembly.
10. Connect the new solenoid to the wiring harness connector.
11. Install the solenoid in the assembly, then install the washer and nut.
12. Place the latch in the assembly. Use a small screwdriver to depress the latch spring during installation. See Figure 8-111. When the latch spring is properly positioned, the free end of the spring will be **vertical** (see Figure 8-112).



Item	Description
1	Latch spring
2	Screwdriver

Figure 8-111 Depress spring during installation

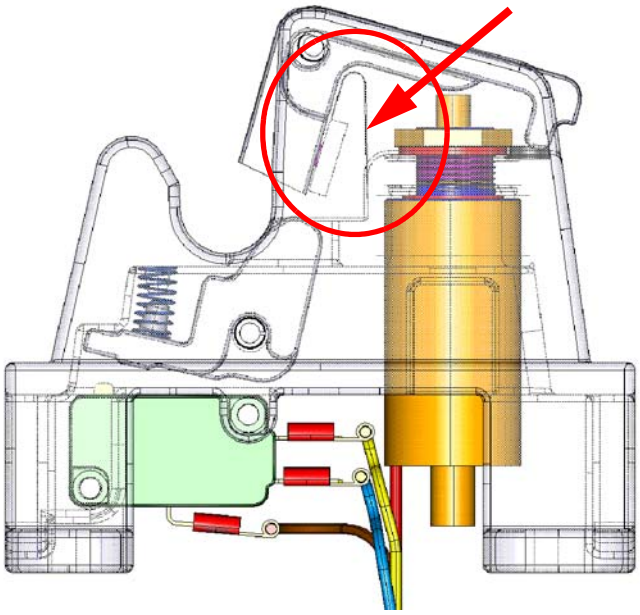


Figure 8-112 Correct latch spring orientation

13. Hold the latch in position and re-install the pin.
14. Verify that the latch operates under tension.
15. Connect the spade connectors to the switch.

16. Install the switch into the assembly and tighten the mounting screws. Take care to apply even force, alternating between screws, so as not to crack/damage the switch.
17. Install the park latch assembly onto the system.
18. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
19. Install the top cover.
20. Install the side covers.

8.5.35.4 Finalization

1. Perform the following mechanical alignment:
   - Check and adjust the mechanical alignment of the park latch assembly and arm yoke for the arm retracted position for smooth and repeatable operation. See 6.1.2 Tube latch to arm pin adjustment procedure on page 108.
   - Check and adjust the mechanical alignment of the column rotational detent position. See 6.1.3 Column rotational detent procedure on page 111,
2. Perform the following functional checks:
   - Drive (speed limited when tube not latched) - see Drive on page 35
   - Drive (reverse-only when bumper switch is pressed) - see Drive on page 35

8.5.36 Digital power supply assembly

Applies to Optima XR220amx and Optima XR200amx with digital upgrade systems only.

8.5.36.1 Personnel requirements

Required persons: 1

Timing (min): 20

8.5.36.2 Preliminary requirements

8.5.36.2.1 Tools and test equipment

- Standard tool kit

8.5.36.2.2 Consumables

- None

8.5.36.2.3 Replacement parts

Item: Digital power supply assembly

Quantity: 1

8.5.36.2.4 Safety

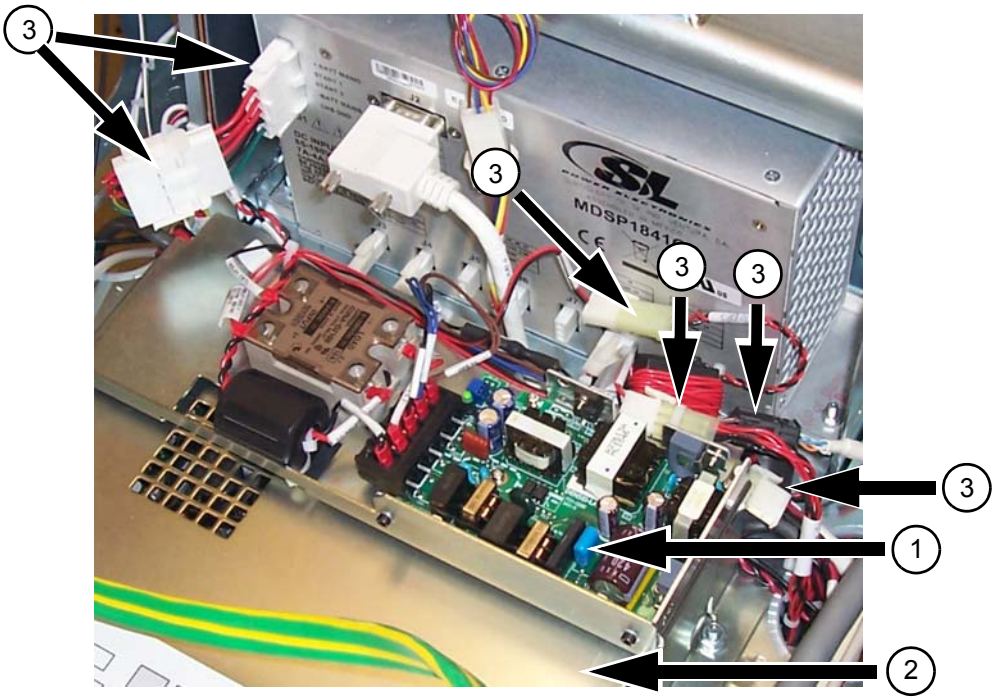
- None

8.5.36.2.5 Required conditions

- Remove the side covers and top cover. See 8.1.2 Top cover removal.

8.5.36.3 Procedure

1. Perform LOTO on the system.
2. See Figure 8-113. Locate the power supply assembly (Item 1).



Item	Description
1	Detector power supply assembly
2	System PC
3	Cable connectors

Figure 8-113 Detector power supply

3. Disconnect the cables (Item 3) from the assembly.
4. Remove the mounting nuts at both ends of the assembly, then remove the old assembly.
5. Install the new power supply assembly and mounting nuts.
6. Re-connect the cables.
7. Install the top cover.
8. Install the side covers.
9. Remove LOTO from the system.

8.5.36.4 Finalization

1. Restore the system to normal operation.
2. Connect a tethered detector to the system and perform an exposure.
3. Verify that an image is created.
4. Insert an un-tethered detector into the bin (with detector battery installed).
5. Verify that when the detector is in the storage bin, the battery LED in the detector handle is lit and blinking.

8.5.37 Collimator lamp power supply

8.5.37.1 Personnel requirements

Required persons: 1

Timing (min): 20

8.5.37.2 Preliminary requirements

8.5.37.2.1 Tools and test equipment

- Standard tool kit
- Anti-static (ESD) kit

8.5.37.2.2 Consumables

- None

8.5.37.2.3 Replacement parts

Item: Collimator lamp power supply

Quantity: 1

8.5.37.2.4 Safety

- None

8.5.37.2.5 Required conditions

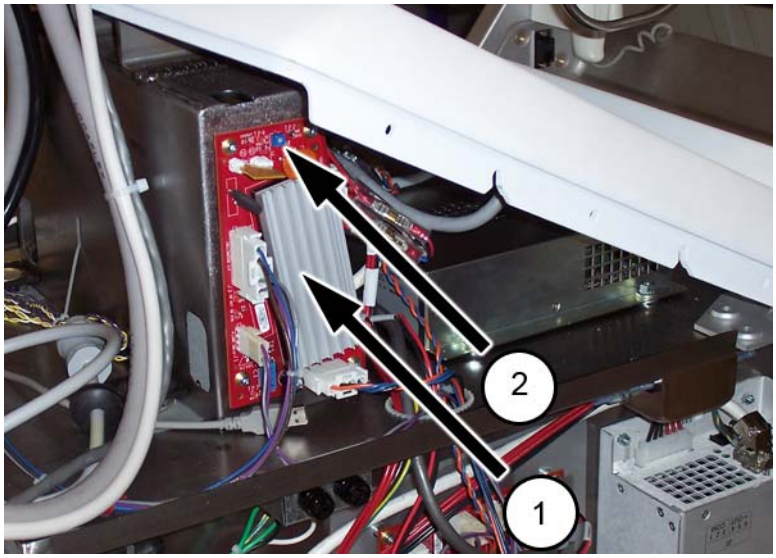
- Remove the left side cover. See 8.1.1 Side cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.37.3 Procedure

ELECTRICAL SHOCK HAZARD

LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current. Ensure you are not providing an earth ground path when practicing ESD procedures. See Section 1.3 Electrostatic discharge (ESD) on page 30.

1. Locate the circuit board. See Figure 8-114.



Item	Description
1	Collimator lamp power supply
2	Collimator lamp supply pot R3

Figure 8-114 Board identification - under top cover

2. Disconnect all cables (3 connections) from the circuit board.
3. Remove the old circuit board (4 screws).
4. Install the new circuit board.
5. Connect all cables to the circuit board.
6. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
7. Install the side cover.

8.5.37.4 Finalization

1. Perform the following adjustment:
   - Adjust the collimator lamp supply potentiometer R3 so that the voltage at the collimator lamp is 20.0 - 22.0 VDC.
2. Perform the following HHS tests:
   - Light field intensity - see 7.1.3.1 Testing light intensity on page 116

8.5.38 Main circuit breaker and cable assembly

8.5.38.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.5.38.2 Preliminary requirements

8.5.38.2.1 Tools and test equipment

- Standard tool kit

8.5.38.2.2 Consumables

- None

8.5.38.2.3 Replacement parts

Item: Main circuit breaker and cable assembly
Quantity: 1

8.5.38.2.4 Safety

- None

8.5.38.2.5 Required conditions

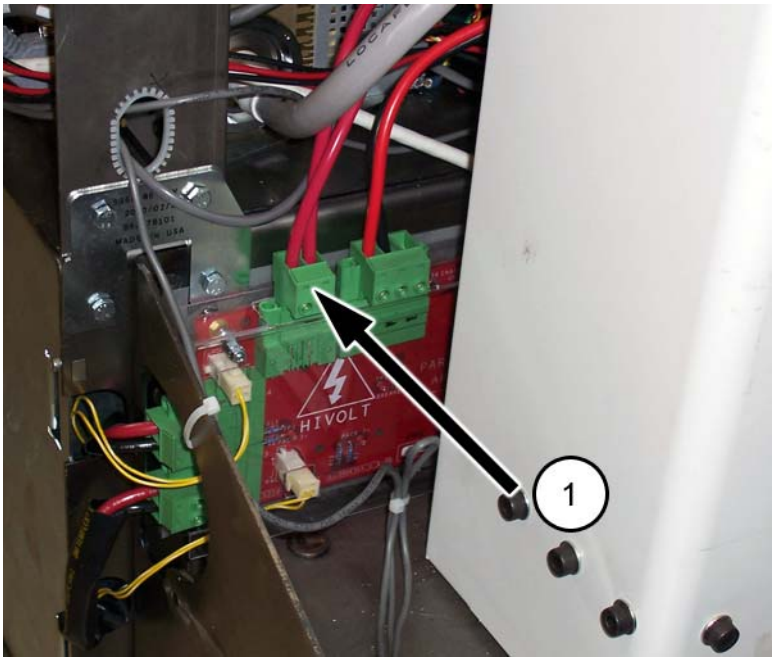
- Remove the side covers and the front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.38.3 Procedure

WARNING

ELECTRICAL SHOCK HAZARD
LOTO must be performed. The mobile system is a battery-powered unit that can deliver lethal current.

1. Locate the battery power connector J5 on the Cricket battery board at the rear of the unit. See Figure 8-115.

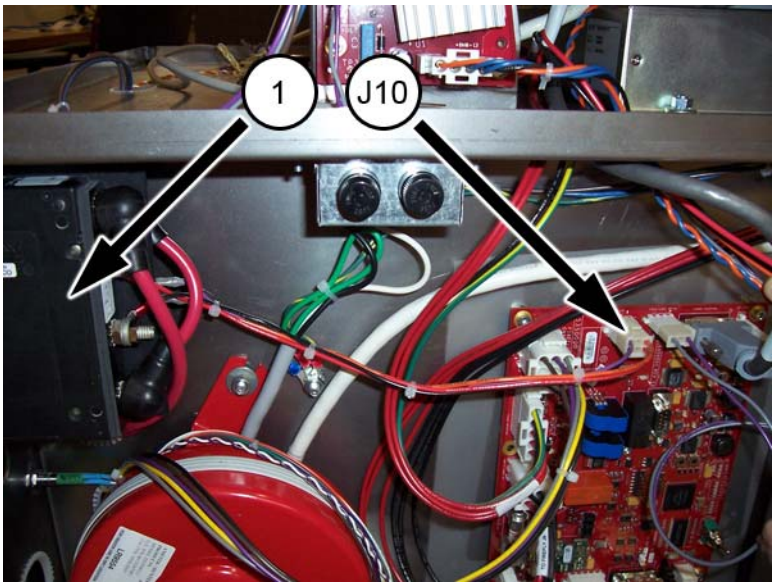


Item	Description
1	Battery power connector J5

Figure 8-115 Battery power connector J5

2. Loosen the two mounting screws and remove the plug from J5 (Breaker I/F) connector.

3. Locate the main circuit breaker and the breaker I/F cable plug (J10) on the Firefly charger board. See Figure 8-116.

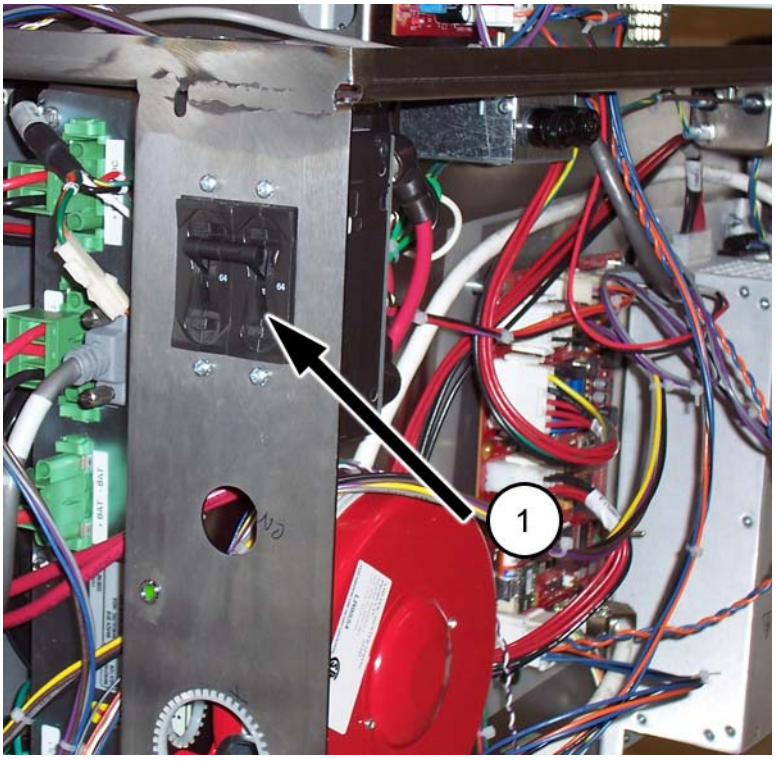


Item	Description
1	Main circuit breaker
J10	Breaker I/F connector on FireFly charger board

Figure 8-116 Main circuit breaker trip - J10

4. Disconnect the cable at J10 on the Firefly charger board.

5. Remove the main circuit breaker (4 screws) and cable assembly. See Figure 8-117.



Item	Description
1	Main circuit breaker

Figure 8-117 Main circuit breaker

6. Install the new circuit breaker.
7. Connect the small cable to J10 on the Firefly charger board.
8. Route the power cable (2 heavy red wires) through the opening in the frame and over to connector J5 on the Cricket battery board.
9. Plug the connector into J5 and tighten the mounting screws.
10. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
11. Install front covers.
12. Install the side covers.

8.5.38.4 Finalization

1. Turn on system power.
2. Verify that the system powers up.

8.5.39 Front bin and inner front bin

8.5.39.1 Personnel requirements

Required persons: 1
Timing (min): 30

8.5.39.2 Preliminary requirements

8.5.39.2.1 Tools and test equipment

- Standard tool kit

8.5.39.2.2 Consumables

- None

8.5.39.2.3 Replacement parts

Item: Front bin
Quantity: 1
or
Item: Inner front bin
Quantity: 1

8.5.39.2.4 Safety

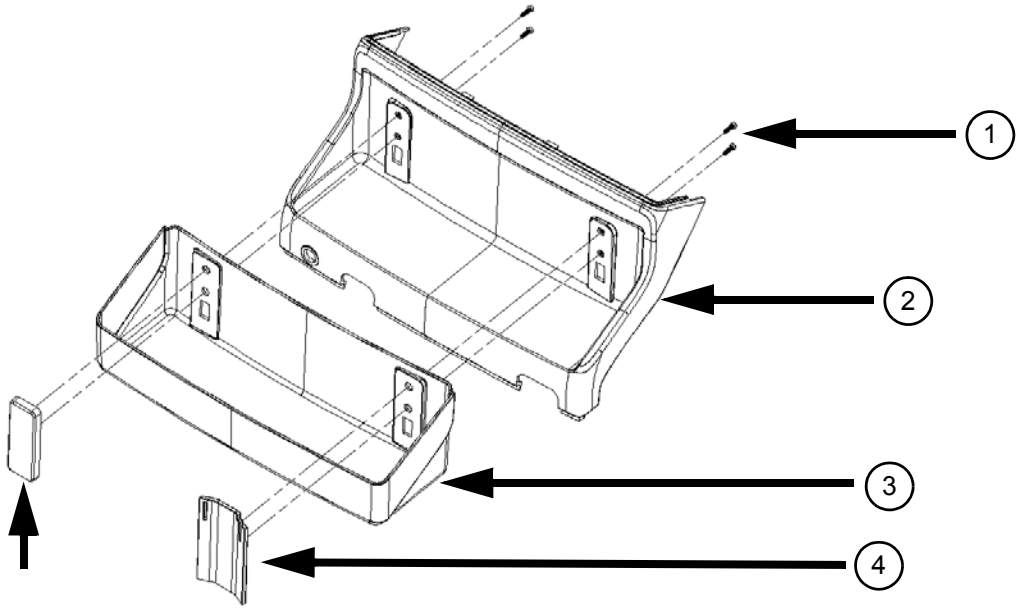
- None

8.5.39.2.5 Required conditions

- Remove the side covers and the top cover. See 8.1.2 Top cover removal.
- Remove the front bin. See 8.1.4 Front bin removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.5.39.3 Procedure

1. See Figure 8-118. Remove the four mounting screws (Item 1) to separate the front bin (Item 2) from the inner front bin (Item 3).



Item	Description
1	Mounting screws
2	Front bin
3	Inner front bin
4	Wipes hold down support
5	Filler blank

Figure 8-118 Front bin assembly

2. Replace the old part (front bin or inner front bin) with the new part and re-assemble the components. To prevent stripping out the wipes hold down support (Item 4) and fillter blank (Item 5) holes, do not over tighten the screws.
3. Install the front bin assembly.
4. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
5. Install the top cover.
6. Install the side covers.

8.5.39.4 Finalization

None

Section 8.6 Column, horizontal arm, X-ray tube, collimator

8.6.1 Engaging vertical lock

8.6.1.1 Personnel requirements

Required persons: 1

Timing (min): 5

8.6.1.2 Preliminary requirements

8.6.1.2.1 Tools and test equipment

- Standard tool kit

8.6.1.2.2 Consumables

- None

8.6.1.2.3 Replacement parts

Item: None

Quantity: None

8.6.1.2.4 Safety

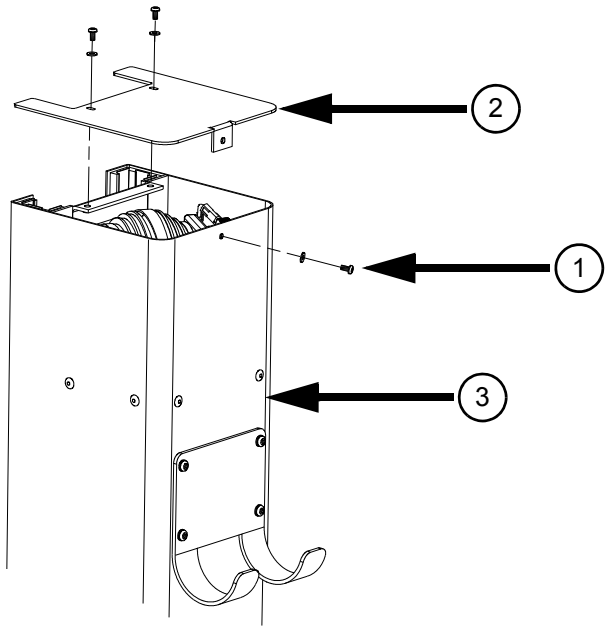
- The column vertical lock must be engaged before any weight (i.e. horizontal arm, X-ray tube, collimator) is removed from the vertical carriage.

8.6.1.2.5 Required conditions

- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.6.1.3 Procedure

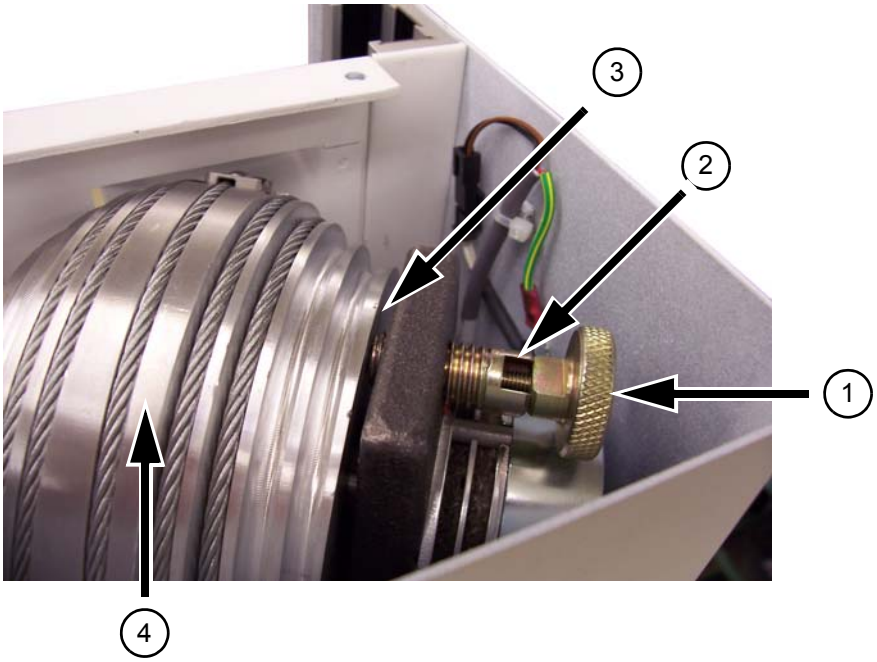
1. See Figure 8-119. Remove the mounting screws (Item 3) and top cover (Item 2) at the top of the vertical column (Item 3).



Item	Description
1	Mounting screws (3 used)
2	Column top cover
3	Column

Figure 8-119 Column top cover

2. Position the horizontal arm to a convenient working position.
3. Lock the vertical carriage:
   a. The vertical lock can engage in multiple positions (approximately 18 cm (7 in.) apart) throughout the vertical range of travel.
   b. See Figure 8-120. At the top of the column, rotate the brass knob (Item 1) 90 degrees until it lines up with, and slightly drops into, the locking notch (Item 2).
   c. Slowly move the horizontal arm up/down until the spring-loaded locking pin clicks into the locking hole (Item 3) in the side of the scroll (Item 4).
   d. Verify that the locking knob is fully seated in the locking notch.
   e. Verify that movement of the vertical carriage has now been locked.



Item	Description
1	Locking knob (shown in the unlocked position)
2	Locking notch
3	Locking holes (2) in side of scroll
4	Cable scroll

Figure 8-120 Column locking mechanism

4. To release the vertical lock, pull back on the locking knob until it clears the locking notch. It may be necessary to provide slight up/down pressure on the horizontal arm to release the lock.
5. Rotate the locking knob 90 degrees and release. In the unlocked position, the knob should appear as shown in Figure 8-121. Verify that the vertical carriage can freely move up/down.

Figure 8-121 Column vertical lock in normal (unlocked) position

6. Install the column top cover.
7. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.

8.6.1.4 Finalization

None required.

8.6.2 Column

8.6.2.1 Personnel requirements

Required persons: 2

Timing (min): 180

8.6.2.2 Preliminary requirements

8.6.2.2.1 Tools and test equipment

- Standard tool kit
- 3mm T-handle hex wrench - hex wrenches with a ball end will not work for some steps in this procedure

8.6.2.2.2 Consumables

- 6 dozen cable ties
- HV Tube Grease (GE part# 46-125224P3, Silicon Grease) or equivalent

8.6.2.2.3 Replacement parts

Item: Column

Quantity: 1

8.6.2.2.4 Safety

- The column vertical lock must be engaged before any weight (i.e. horizontal arm, X-ray tube, collimator) is removed from the vertical carriage.

8.6.2.2.5 Required conditions

- Remove the side covers and the front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Remove the column skirt covers. See 8.1.6 Column skirt cover removal.

8.6.2.3 Procedure

Note: The carriage safety lock system is designed to limit downward motion of the horizontal arm / tube assembly should an event occur where there is an imbalance in the counterweight system. In this situation the carriage safety lock will engage to prevent the horizontal arm / tube assembly from falling downward. However the horizontal arm / tube assembly can be ratcheted upwards when the carriage safety lock is engaged.

Always be certain of the cause of the carriage safety lock engagement before disengaging the carriage safety lock. If the carriage safety lock has engaged due to a problem in the counterweight system it is critical to resolve that problem before disengaging the carriage safety lock.

When performing the column replacement procedure it is possible that the carriage safety lock may become engaged if the carriage assembly is lifted upwards while the column vertical lock is engaged. This is the only situation where the procedure below should be applied.

If the carriage safety lock becomes engaged while performing this procedure, use the following steps to disengage it:

a. Ensure that the horizontal arm, tube, and collimator are installed and the vertical lock is engaged. See 8.6.1 Engaging vertical lock.

b. Remove the 4 screws and carriage cover plate. See Figure 8-122.

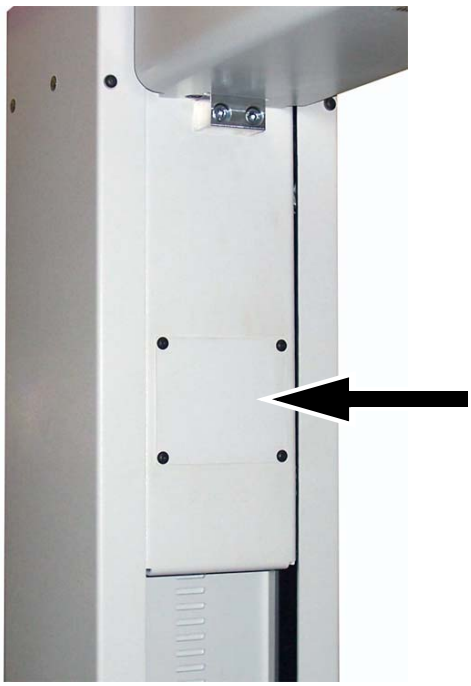


Figure 8-122 Carriage cover plate

c. With one person lifting up slightly on the horizontal arm, have the other person pry the carriage safety lock upwards with a large flat blade screwdriver. See Figure 8-123.

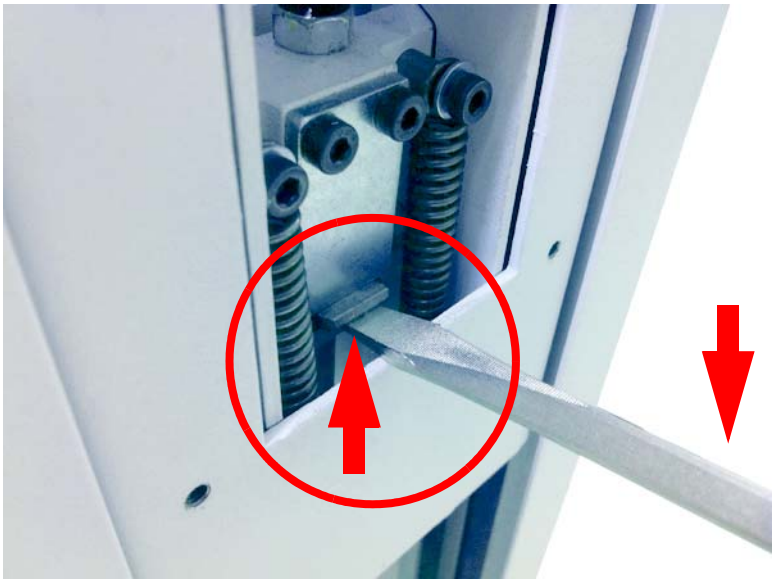


Figure 8-123 Release safety lock

d. Once the carriage safety lock is disengaged, slowly lower the horizontal arm until the steel cable is supporting the weight.

e. Install the carriage cover plate and 4 screws.

f. Disengage the vertical lock.

1. Lock the vertical carriage. See 8.6.1 Engaging vertical lock.
2. Remove the 4 fasteners and the carriage cover plate from the carriage. See Figure 8-124. Save these parts to use on the new carriage.

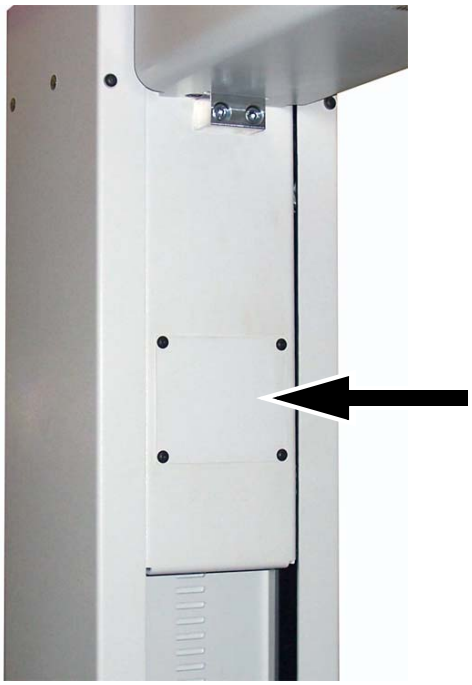


Figure 8-124 Carriage cover plate

3. Using caution, as these parts are under tension from the springs, remove both spring cap screws. The hardware on these cap screws is very easy to fall off the cap screw and drop down into the column. It is best to use a T-handle hex wrench for this task; hex wrenches with a ball end will not work well. Note the order in which the hardware is placed on the cap screws. See Figure 8-125.

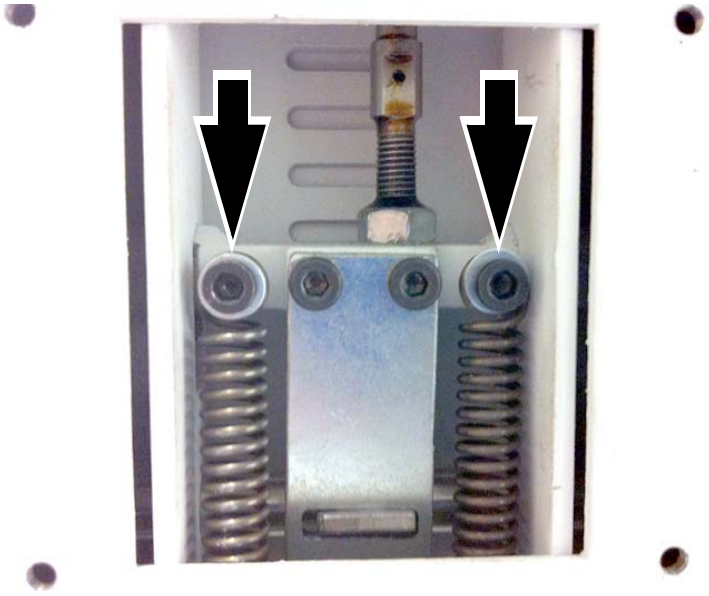


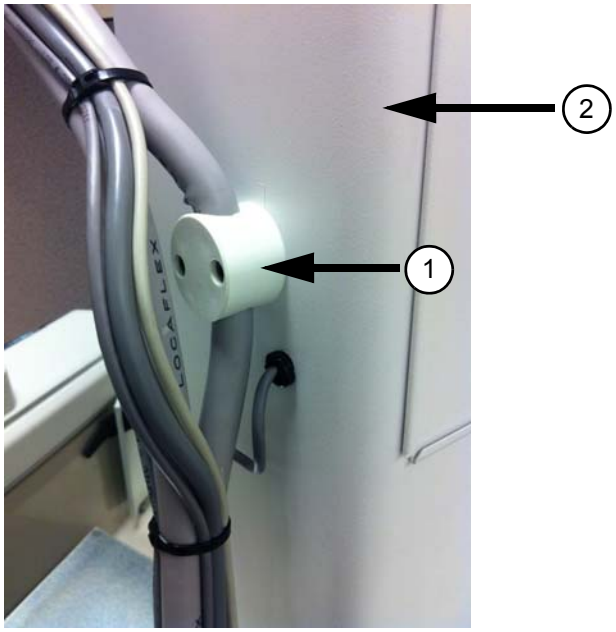
Figure 8-125

4. Remove the cap screws, collars, and washers from the old carriage. Save these parts to use on the new carriage.
5. Mark the location of existing cables ties and then remove cable ties as necessary to free the column of any cable restraints or obstructions.

Note: 'Temporary' cable ties can be used to mark the location of the old ties; they also help to hold the relative position of the cables to each other when the old ties are removed. These ties are temporary and will be removed during reassembly.

6. Remove the collimator. See 8.6.9.1 Collimator replacement.

7. Remove the X-ray tube. See 8.6.8 Toshiba X-ray tube.
8. Remove the horizontal arm. See 8.6.3 Horizontal arm assembly.
9. See Figure 8-126. Remove the cable bracket (Item 1) from the side of the column.



Item	Description
1	Column cable bracket
2	Column

Figure 8-126 Column cable bracket

10. Remove the front bin. See 8.1.4 Front bin removal.
11. Remove the bottom portion of the cable clamp. See Figure 8-127.

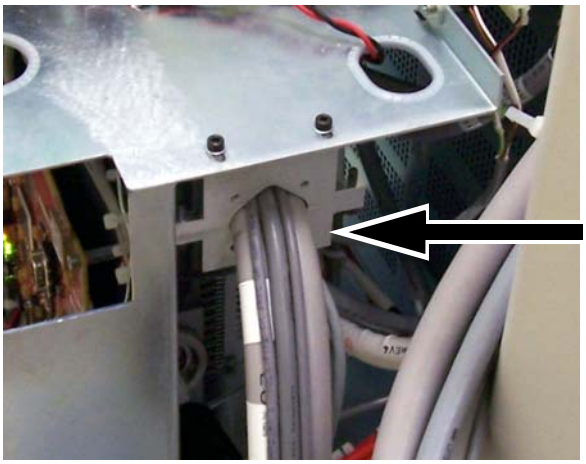


Figure 8-127 Cable clamp (bottom portion)

12. Remove the cable labelled "TO COL BULKHEAD" from the main bulkhead (J2 and ground). See Figure 8-128.

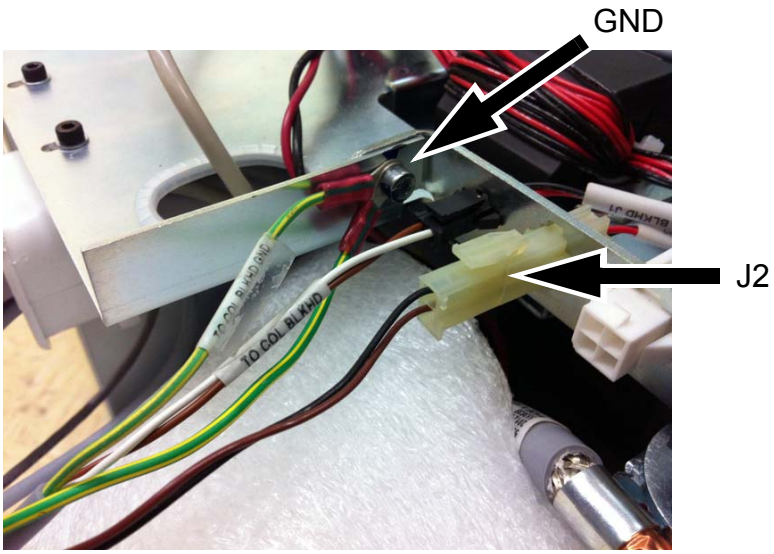
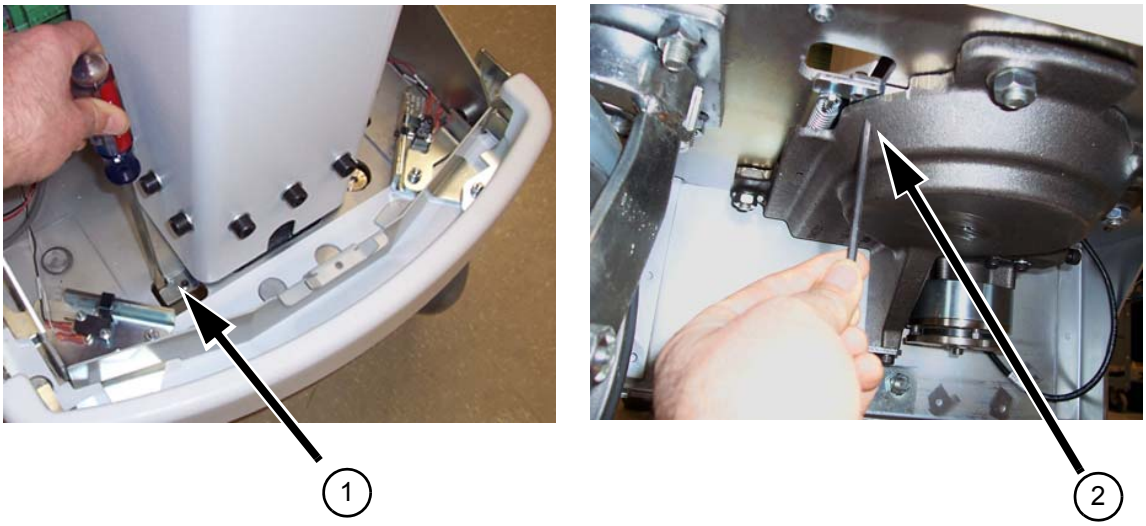


Figure 8-128 Remove J2 and ground

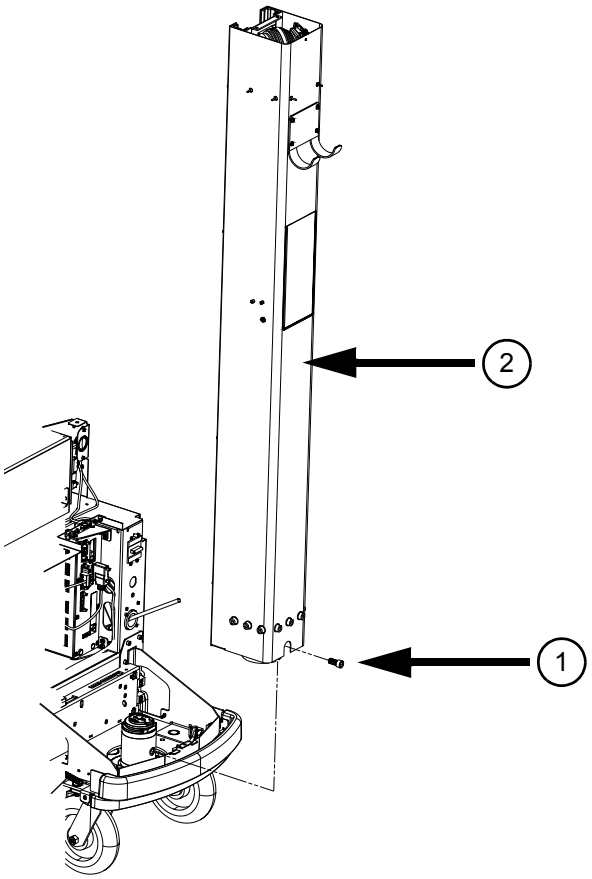
13. See Figure 8-129. Use a large screwdriver at the base of the vertical column to move the spring-loaded column rotational detent arm (Item 1) toward the front of the unit. From underneath the base, insert a 5/32" (4 mm) allen wrench into the hole in the cover (Item 2) to hold the rotational detent arm away from the column.



Item	Description
1	Spring-loaded column rotational detent arm
2	Hole to lock column rotational detent arm

Figure 8-129 Release column rotational detent

14. See Figure 8-130. Rotate the column to obtain access to the column bolt (Item1), then remove the bolt.



Item	Description
1	Column mounting bolt
2	Column

Figure 8-130 Column mounting bolt

15. Using two people, lift the column off of the chassis and set aside.
16. Using two people, lift the new column into position on the chassis and install the column mounting bolt. Torque to 90 N-m (66.4 lb-ft) - no thread locker is used.
17. Remove the allen wrench that was used to hold the rotational detent arm.
18. Install the cable bracket onto the column.
19. Install the horizontal arm.
20. Install the X-ray tube. See Figure 8-21, Figure 8-22 and Figure 8-23 for cable routing at the rear of the X-ray tube.
21. Install the collimator.
22. Install the new cable labelled "TO COL BULKHEAD" to the main bulkhead (J2 and ground).
23. Install the bottom portion of the cable clamp.
24. Install cable brackets and cable ties.

25. On the new carriage, install the hardware that was removed from the old carriage in step 4. A standard 3mm T-handle hex wrench is required; hex wrenches with a ball end will not work well. Using the T-handle hex wrench, carefully pull the assembled hardware upwards and towards the threaded hole. Get the cap screw edge into the threaded hole then pry the cap screw up and screw it in. Torque to 2.3 N-m (20.4 in-lbs). See Figure 8-131, Figure 8-132 & Figure 8-133.

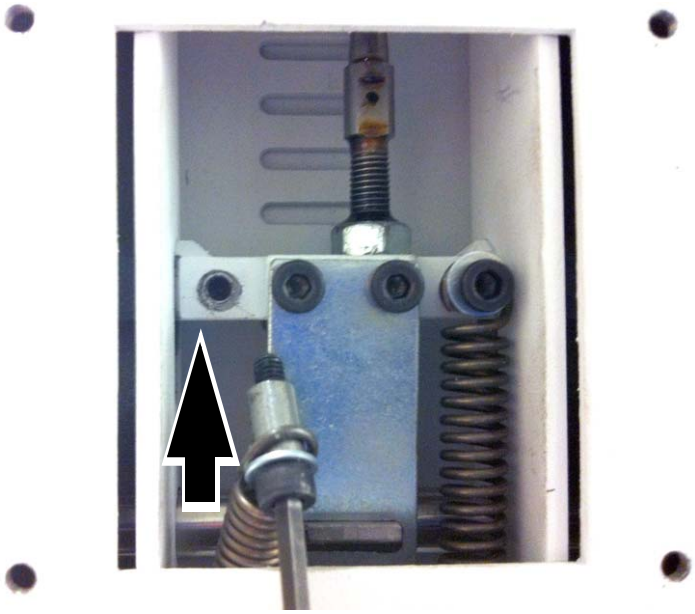


Figure 8-131

Figure 8-132

Figure 8-133

26. Install the carriage cover plate and screws.

NOTICE

Examine the steel cables at the top of the column to ensure proper tension has been maintained prior to unlocking the vertical carriage. If the safety lock has been engaged, disengaging the vertical carriage lock can result in uncontrolled cable tension and/or equipment damage, resulting in column replacement. For details on releasing the safety lock, see Column Replacement, 8.6.2.3 Procedure on page 318.

27. Unlock the vertical carriage and install the column top cover.
28. Install the front bin.
29. Install the column skirt covers.
30. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
31. Install the front covers.
32. Install the side covers.

8.6.2.4 Finalization

1. Perform the following mechanical alignments:
   - Check and adjust the mechanical alignment of the park latch assembly and arm yoke for the arm retracted position for smooth and repeatable operation. See 6.1.2 Tube latch to arm pin adjustment procedure on page 108.
   - Check and adjust the mechanical alignment of the column rotational detent position. See 6.1.3 Column rotational detent procedure on page 111.
   - Check and adjust the Column Balance. See 6.1.1 Column balance procedure on page 105.
2. Perform the following functional checks:
   - Tube column and arm - see Tube column and arm on page 35
   - X-ray - see X-ray on page 36
3. Perform the following HHS checks:

- Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117

4. For Optima XR220amx and Optima XR200amx with Digital Upgrade:
   - Perform QAP - refer to the Installation Manual, Chapter 6 - Detector checks and QAP

8.6.3 Horizontal arm assembly

8.6.3.1 Personnel requirements

Required persons: 1

Timing (min): 120

8.6.3.2 Preliminary requirements

8.6.3.2.1 Tools and test equipment

- Standard tool kit

8.6.3.2.2 Consumables

- Loctite 271 (GE part# 46-170684P1) or equivalent
- HV Tube Grease (GE part#46-125224P3, Silicon Grease) or equivalent
- Cable ties

8.6.3.2.3 Replacement parts

Item: Horizontal arm assembly

Quantity: 1

8.6.3.2.4 Safety

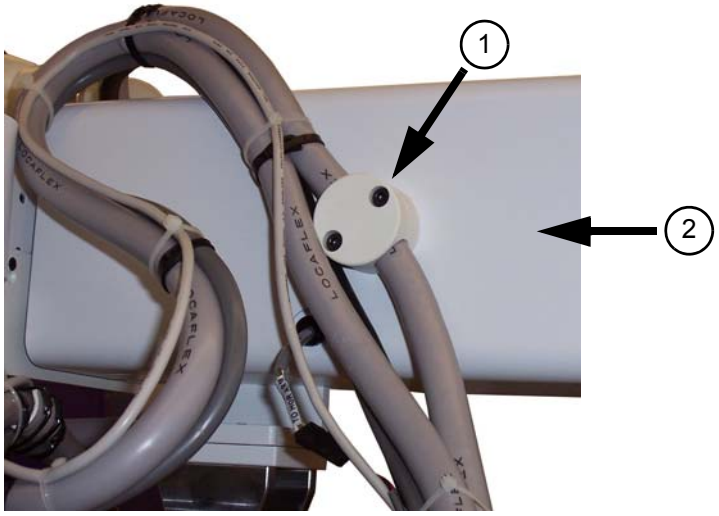
- The column vertical lock must be engaged before any weight (i.e. horizontal arm, X-ray tube, collimator) is removed from the vertical carriage.

8.6.3.2.5 Required conditions

- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.6.3.3 Procedure

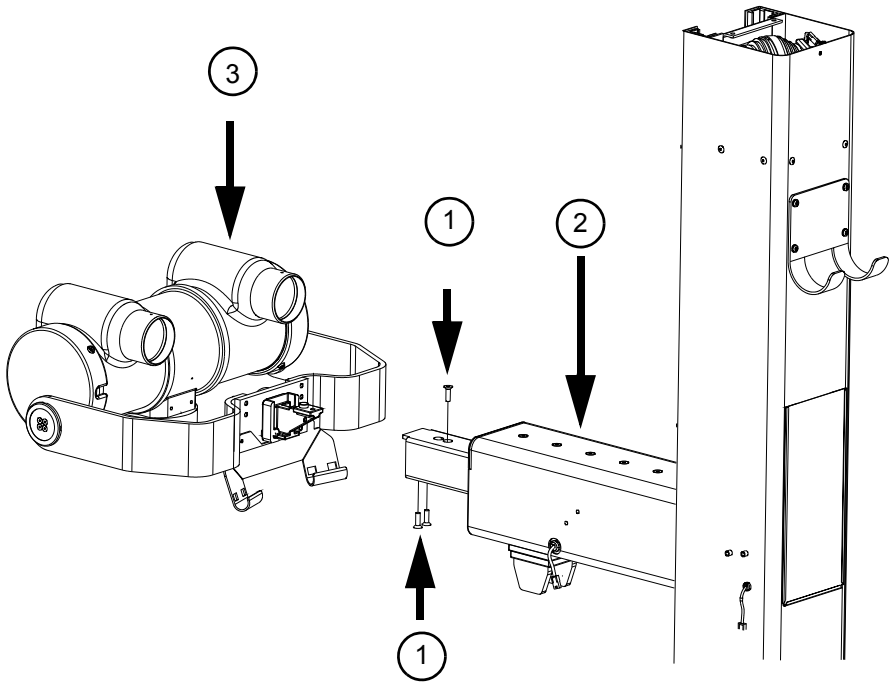
1. Lock the vertical carriage. See 8.6.1 Engaging vertical lock.
2. Remove the collimator. See 8.6.9.1 Collimator replacement.
3. Remove the tube covers. See 8.1.7 Tube head cover removal.
4. Lightly mark the positions of all cable clamps and cable ties on the side of the existing cables, then cut and remove the cable ties.
5. See Figure 8-134. Remove the cable clamp (Item 1) from the side of the horizontal arm (Item 2).



Item	Description
1	Horizontal arm cable bracket
2	Horizontal arm

Figure 8-134 Horizontal arm cable bracket

6. See Figure 8-135. Remove the three tube yoke mounting screws (Item 1) from the horizontal arm (Item 2).

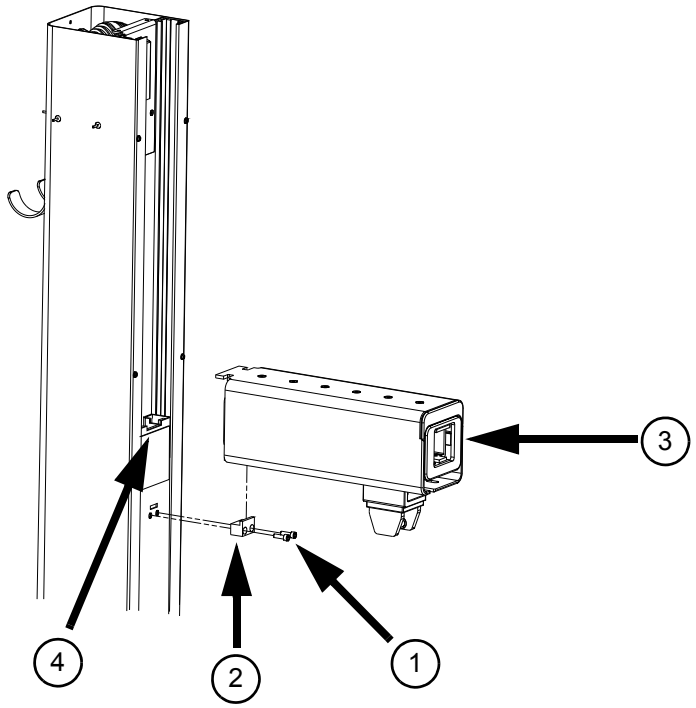


Item	Description
1	Tube yoke mounting screws (3 used)
2	Horizontal arm
3	X-ray tube/yoke assembly

Figure 8-135 X-ray tube mount

7. Tip the front of the X-ray tube assembly upward and slide the assembly out of the horizontal arm. Set the assembly on the work surface.

8. See Figure 8-136. Remove the two mounting screws (Item 1) and the mounting block (Item 2) from the horizontal arm (Item 3).



Item	Description
1	Mounting screws
2	Mounting block
3	Horizontal arm
4	Vertical carriage

Figure 8-136 Horizontal arm

9. Tip the front of the horizontal arm upward and lift the arm off of the vertical carriage (Item 4). Set the old horizontal arm aside on the work surface.
10. Install the new horizontal arm, mounting block and mounting screws. Torque to 7.9 N-m (5.8 lb-ft) - no thread locker is used.
11. Install the X-ray tube and yoke assembly. Apply thread locker (Loctite 271 or equivalent) and torque the 3 fasteners as follows;
    - Single top fastener = 26.8 N-m (19.9 lb-ft)
    - Two bottom fasteners = 13.3 N-m (9.8 lb-ft)
12. Install the cable bracket to the side of the horizontal arm. Route the cables and apply cable ties as shown in Figure 8-21, Figure 8-22 and Figure 8-23.
13. Install new cable ties on the remainder of the cable drape.
14. Install the tube covers.
15. Install the collimator.

NOTICE

Examine the steel cables at the top of the column to ensure proper tension has been maintained prior to unlocking the vertical carriage. If the safety lock has been engaged, disengaging the vertical carriage lock can result in uncontrolled cable tension and/or equipment damage, resulting in column replacement. For details on releasing the safety lock, see Column Replacement, 8.6.2.3 Procedure on page 318.

16. Unlock the vertical carriage.
17. Install the column top cover.
18. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.

8.6.3.4 Finalization

1. Perform the following mechanical alignments:
   - Check and adjust the mechanical alignment of the park latch assembly and arm yoke for the arm retracted position for smooth and repeatable operation. See 6.1.2 Tube latch to arm pin adjustment procedure on page 108.
   - Check and adjust the Column Balance. See 6.1.1 Column balance procedure on page 105.
2. Perform the following functional checks:
   - Tube column and arm - see Tube column and arm on page 35
   - X-ray - see X-ray on page 36
3. Perform the following HHS checks:
   - Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117
4. For Optima XR220amx and Optima XR200amx with Digital Upgrade:
   - Perform QAP - refer to the Installation Manual, Chapter 6 - Detector checks and QAP

8.6.4 Horizontal arm brake cable assembly with track

8.6.4.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.6.4.2 Preliminary requirements

8.6.4.2.1 Tools and test equipment

- Standard tool kit

8.6.4.2.2 Consumables

- Cable ties

8.6.4.2.3 Replacement parts

Item: Horizontal arm brake cable assembly with track

Quantity: 1

8.6.4.2.4 Safety

- The column vertical lock must be engaged before any weight (i.e. horizontal arm, X-ray tube, collimator) is removed from the vertical carriage.

8.6.4.2.5 Required conditions

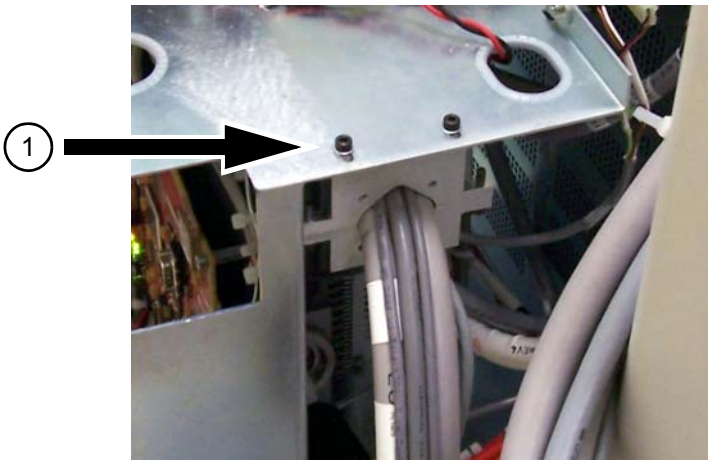
- Remove the side covers, front covers and front bin. See 8.1.4 Front bin removal on page 156.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.6.4.3 Procedure

1. See Figure 8-137. Disconnect the horizontal arm brake cable from the Thorax bulkhead (J1).

Figure 8-137 Horizontal arm brake cable - Thorax bulkhead J1

2. Remove the HV cable clamp mounting screws. See Figure 8-138.



Item	Description
1	HV cable clamp mounting screws (2)

Figure 8-138 HV cable clamp mounting screws

3. Remove the clamp from the HV cable bundle. See Figure 8-139.

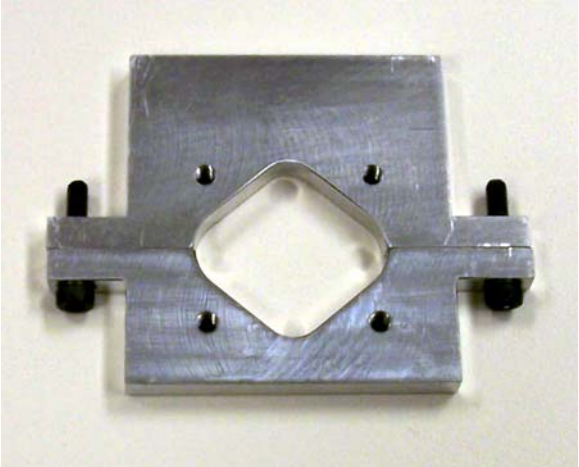
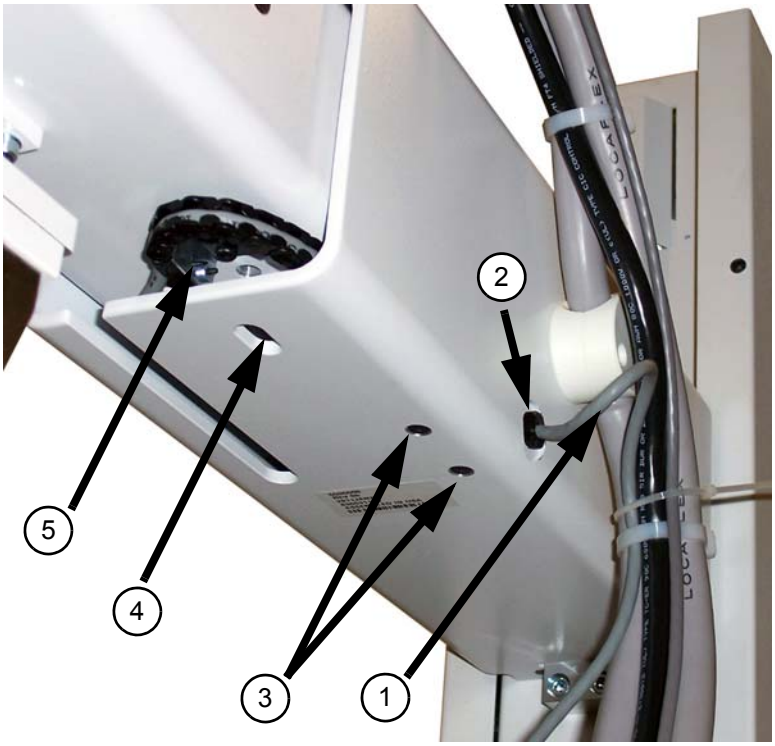


Figure 8-139 HV cable clamp

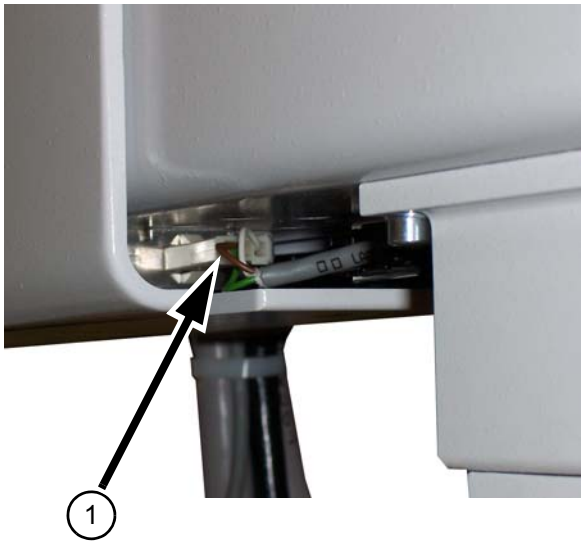
4. Follow the horizontal arm brake cable back through the cable drape. At each existing cable tie, mark the location of the cable tie on an adjacent cable, then cut and remove the cable tie.
5. Position the horizontal arm to a convenient work position, then lock the vertical carriage. See 8.6.1 Engaging vertical lock.
6. See Figure 8-140. Remove the bushing (Item 2) from the horizontal arm.
7. Remove the two bracket mounting screws (Item 3) from the bottom of the horizontal arm.
8. Adjust the horizontal arm extension so that the cable mounting screws (Item 5) line up with the access opening (Item 4). Remove the two screws.



Item	Description
1	Horizontal arm brake cable
2	Bushing
3	Bracket mounting screws
4	Access opening
5	Cable mounting screws

Figure 8-140 Horizontal arm brake cable

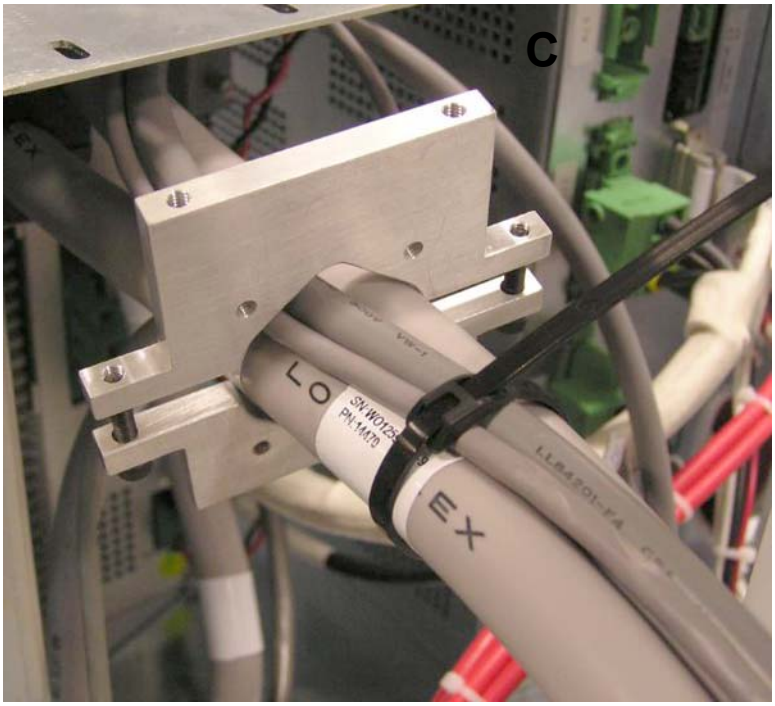
9. See Figure 8-141. Inside the horizontal arm, disconnect the cable from the plug (Item 1).

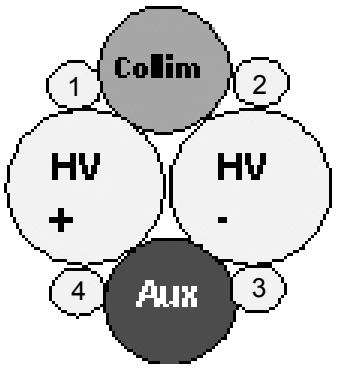


Item	Description
1	Horizontal arm brake cable plug

Figure 8-141 Horizontal arm brake cable plug

10. Remove the old horizontal arm cable.
11. Route the new cable through the opening in the side of the horizontal arm.
12. Line up the mounting bracket and install the two screws (see Figure 8-140 Item 2).
13. Inside the horizontal arm, connect the cable to the plug (see Figure 8-141 Item 1).
14. Adjust the horizontal arm extension so that the cable mounting screw bracket (see Figure 8-140 Item 5) lines up with the access opening (see Figure 8-140 Item 4). Install the two screws.
15. Install the bushing (see Figure 8-140 Item 2) in the side of the horizontal arm.
16. Route the horizontal arm brake cable back through the cable drape to the Thorax bulkhead, attaching cable ties at the marks placed in Step 4 above.
17. Arrange the cable bundle as shown in Figure 8-142, use a cable tie to maintain cable positions.
18. Install the clamp onto the cable bundle. DO NOT TIGHTEN THE CLAMP YET.
19. Mount the clamp to the Thorax chassis. Slide the clamp to the rear of the mounting screw slots.
20. Tighten the clamp around the cable bundle, ensuring that the cables are not pinched by the clamp.





Item	Description
1	DAP cable (optional for Optima XR200amx systems)
2	Wireless cable (only valid for Optima XR220amx systems)
3	Vertical brake cable
4	Horizontal arm lock cable

Figure 8-142 Correct cable bundle arrangement

21. Plug the horizontal arm brake cable into J1 on the Thorax bulkhead.

NOTICE

Examine the steel cables at the top of the column to ensure proper tension has been maintained prior to unlocking the vertical carriage. If the safety lock has been engaged, disengaging the vertical carriage lock can result in uncontrolled cable tension and/or equipment damage, resulting in column replacement. For details on releasing the safety lock, see Column Replacement, 8.6.2.3 Procedure on page 318.

22. Unlock the vertical carriage.
23. Install the column top cover.
24. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
25. Install the front bin.
26. Install the front covers.
27. Install the side covers.

8.6.4.4 Finalization

Perform the following functional checks:

- Tube column and arm - see Tube column and arm on page 35

8.6.5 Tube mount - detent side (cathode side)

8.6.5.1 Personnel requirements

Required persons: 1

Timing (min): 120

8.6.5.2 Preliminary requirements

8.6.5.2.1 Tools and test equipment

- Standard tool kit

8.6.5.2.2 Consumables

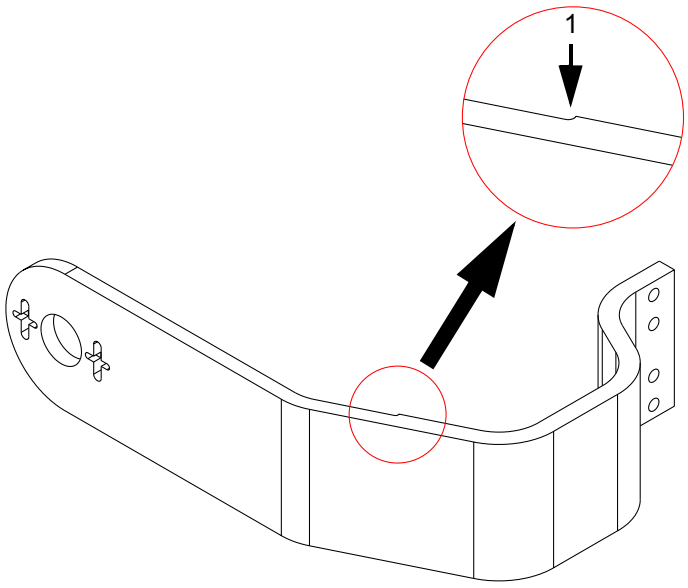
- Loctite 271 (GE part# 46-170684P1) or equivalent
- Cable ties
- HV Tube Grease (GE part# 46-125224P3, Silicon Grease) or equivalent

8.6.5.2.3 Replacement parts

Item: Tube mount - detent side (cathode side)

Quantity: 1

Note 1: A newer version of this part has been introduced. It is not backward-compatible with the original version. If replacing the original version, you must replace **BOTH** sides with the newer version. The newer version is physically longer. Mixing old and new versions results in tube attachment mis-alignment. See Figure 8-143 for identification of mounts.



Item	Description
1	A thickness notch in this location identifies a newer version tube mount

Figure 8-143 Tube mount identification

WARNING

CRUSH HAZARD

Note 2: The yolk mounting fasteners for the new version are longer than the original version. These fasteners are provided with the new version replacement part and **MUST** be used.

8.6.5.2.4 Safety

- The column vertical lock must be engaged before any weight (i.e. horizontal arm, X-ray tube, collimator) is removed from the vertical carriage.

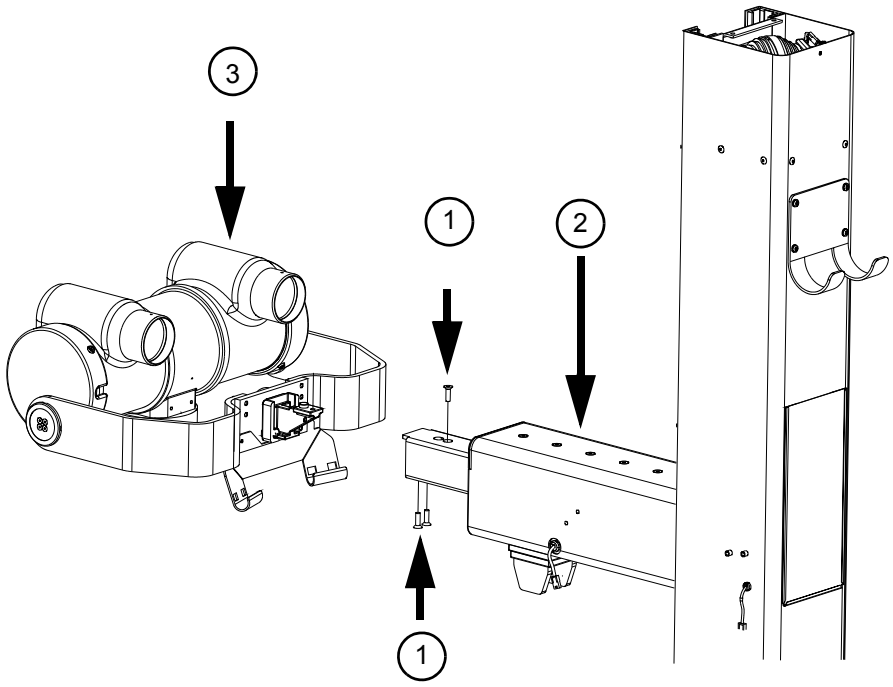
8.6.5.2.5 Required conditions

- Remove the side covers and front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Remove the collimator. See 8.6.9 Collimator.
- Remove the tube covers. See 8.1.7 Tube head cover removal.

8.6.5.3 Procedure

1. Position the unit next to a work surface that can safely support the X-ray tube/yoke assembly.
2. Lock the vertical carriage. See 8.6.1 Engaging vertical lock.
3. Remove the collimator. See 8.6.9.1 Collimator replacement.
4. Remove the HV cables from the X-ray tube wells. Protect the HV cable ends to prevent damage.
5. Disconnect the rotor cable from the generator J6 connector, and free the rotor cable from the cable drape marking the location of the cable ties.

6. See Figure 8-144. Remove the three tube yoke mounting screws (Item 1) from the horizontal arm (Item 2).

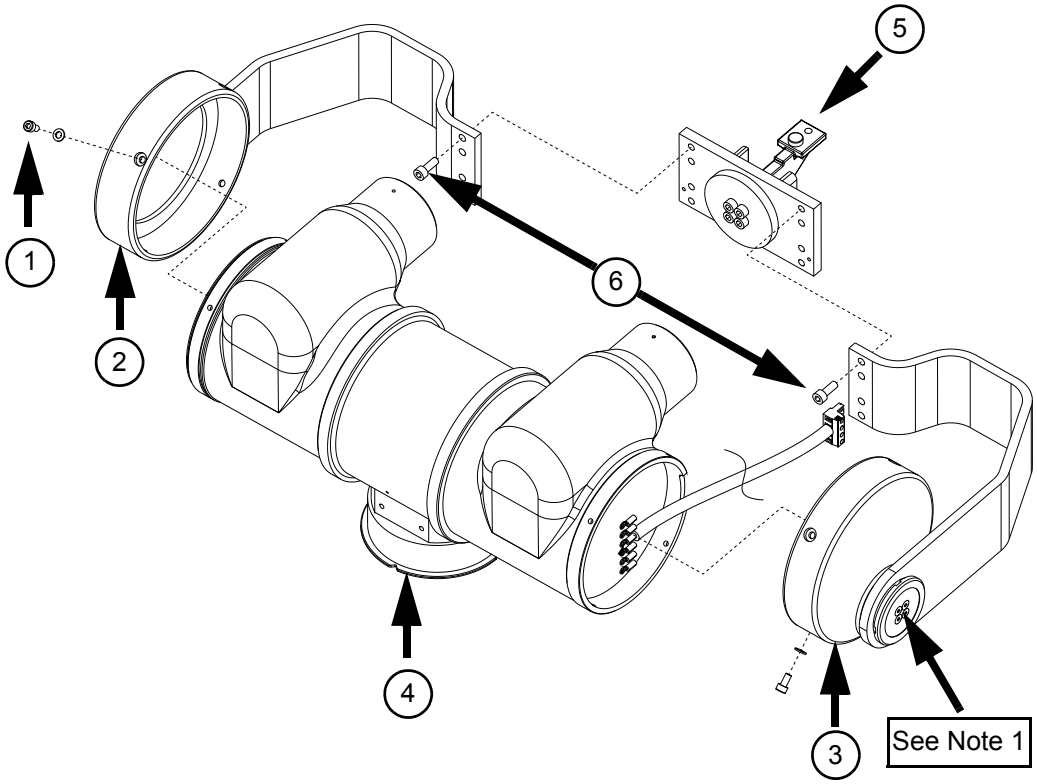


Item	Description
1	Tube yoke mounting screws (3 used)
2	Horizontal arm
3	X-ray tube/yoke assembly

Figure 8-144 X-ray tube mount

7. Tip the front of the X-ray tube assembly upward and slide the assembly out of the horizontal arm. Set the assembly on the work surface.

8. See Figure 8-145. Remove the four end cap mounting screws (Item 1) from the cathode end cap (Item 2).



NOTICE

Note 1: Do NOT loosen or disturb the screws in this location. These are non-servicable items and require specialized fixtures for proper assembly. This applies to both the cathode and anode sides.

Item	Description
1	End cap mounting screws (4 used on each end cap)
2	Cathode end cap and tube mount
3	Anode end cap and tube mount
4	X-ray tube
5	Yoke
6	Tube mount screws (4 used on each side) New version length = 20 mm (0.78 in.) - used in Step 12

Figure 8-145 X-ray tube mount

9. Remove the four tube mount screws (Item 6) from the yoke (Item 5).
10. Remove the cathode end cap / tube mount assembly from the X-ray tube (Item 4).
11. Install the new end cap / tube mount assembly onto the X-ray tube.
12. Install and tighten the four tube mount screws (apply thread locker and torque to 13.2 N-m (9.7 lb-ft)) and the four end cap screws (apply thread locker and torque to 2.5 N-m (1.8 lb-ft)).

13. Tip the front of the X-ray tube assembly upward and slide the assembly into the horizontal arm.
14. Install the X-ray tube and yoke assembly. Apply thread locker (Loctite 271 or equivalent) and torque the 3 fasteners as follows;
    - Single top fastener = 26.8 N-m (19.9 lb-ft)
    - Two bottom fasteners = 13.3 N-m (9.8 lb-ft)
15. Route and connect the rotor cable to the generator.
16. Install the tube covers.
17. Install the collimator. Route and connect the collimator cable to the Thorax bulkhead J4 and J5 connectors and chassis ground.
18. Insert the HV cables into the X-ray tube HV wells and tighten the mounting rings. Make sure that the cable markings (Tube Anode or Tube Cathode) match up with the X-ray tube marking (Anode or Cathode). See Figure 8-21, Figure 8-22 and Figure 8-23 for cable routing at the rear of the X-ray tube, if necessary.
19. Replace the cable ties and secure the cable drape.

NOTICE

Examine the steel cables at the top of the column to ensure proper tension has been maintained prior to unlocking the vertical carriage. If the safety lock has been engaged, disengaging the vertical carriage lock can result in uncontrolled cable tension and/or equipment damage, resulting in column replacement. For details on releasing the safety lock, see Column Replacement, 8.6.2.3 Procedure on page 318.

20. Unlock the vertical carriage.
21. Install the column top cover.
22. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
23. Install the front covers.
24. Install the side covers.

8.6.5.4 Finalization

1. Perform the following functional checks:
    - Tube column and arm - see Tube column and arm on page 35
2. Perform the following HHS checks:
    - Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117
3. For Optima XR220amx and Optima XR200amx with Digital Upgrade:
    - Perform QAP - refer to the Installation Manual, Chapter 6 - Detector checks and QAP

8.6.6 Tube mount - friction side (anode side)

8.6.6.1 Personnel requirements

Required persons: 1

Timing (min): 120

8.6.6.2 Preliminary requirements

8.6.6.2.1 Tools and test equipment

- Standard tool kit

8.6.6.2.2 Consumables

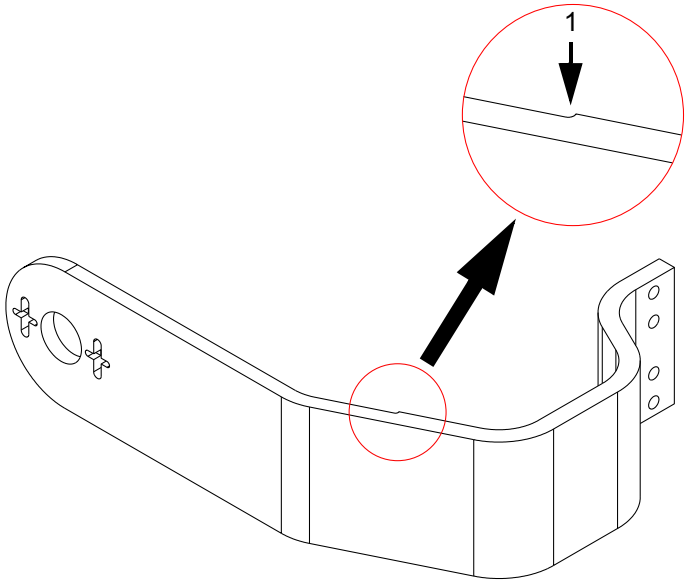
- Cable ties
- Loctite 271 (GE part# 46-170684P1) or equivalent
- HV Tube Grease (GE part# 46-125224P3, Silicon Grease) or equivalent

8.6.6.2.3 Replacement parts

Item: Tube mount - friction side (anode side)

Quantity: 1

Note 1: A newer version of this part has been introduced. It is not backward-compatible with the original version. If replacing the original version, you must replacement **BOTH** sides with the newer version. The newer version is physically longer. Mixing old and new versions results in tube attachment mis-alignment. See Figure 8-146 for identification of mounts.



Item	Description
1	A thickness notch in this location identifies a newer version tube mount

Figure 8-146 Tube mount identification

WARNING

CRUSH HAZARD

Note 2: The yolk mounting fasteners for the new version are longer than the original version. These fasteners are provided with the new version replacement part and **MUST** be used.

8.6.6.2.4 Safety

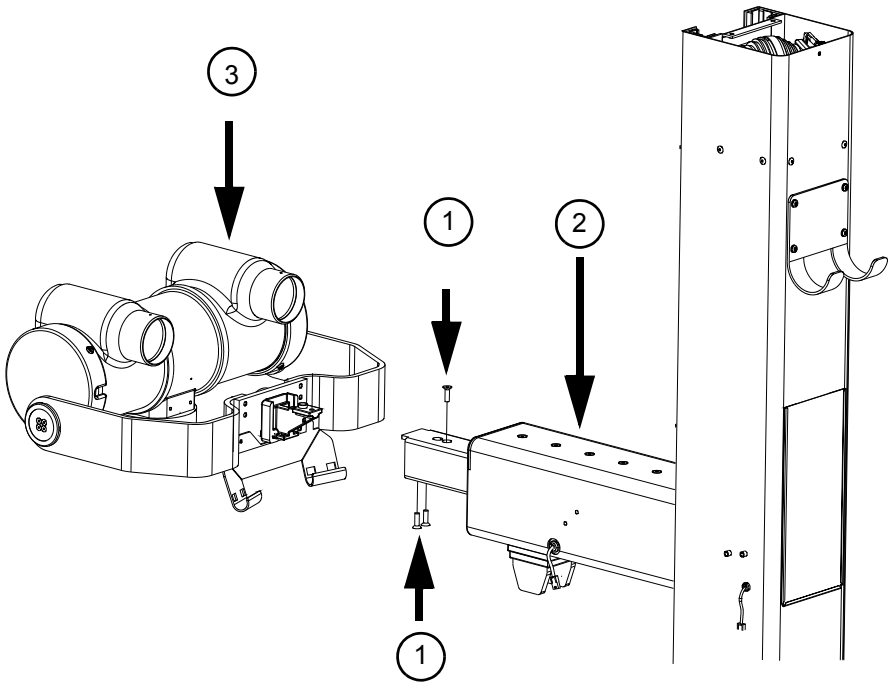
- The column vertical lock must be engaged before any weight (i.e. horizontal arm, X-ray tube, collimator) is removed from the vertical carriage.

8.6.6.2.5 Required conditions

- Remove the side covers and front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Remove the collimator. See 8.6.9 Collimator.
- Remove the tube covers. See 8.1.7 Tube head cover removal.

8.6.6.3 Procedure

1. Position the unit next to a work surface that can safely support the X-ray tube/yoke assembly.
2. Lock the vertical carriage. See 8.6.1 Engaging vertical lock.
3. Remove the collimator. See 8.6.9.1 Collimator replacement.
4. Remove the HV cables from the X-ray tube wells. Protect the HV cables to prevent damage.
5. Disconnect the rotor cable from the generator J6 connector, and free the rotor cable from the cable drape marking the location of the cable ties.
6. See Figure 8-147. Remove the three tube yoke mounting screws (Item 1) from the horizontal arm (Item 2).

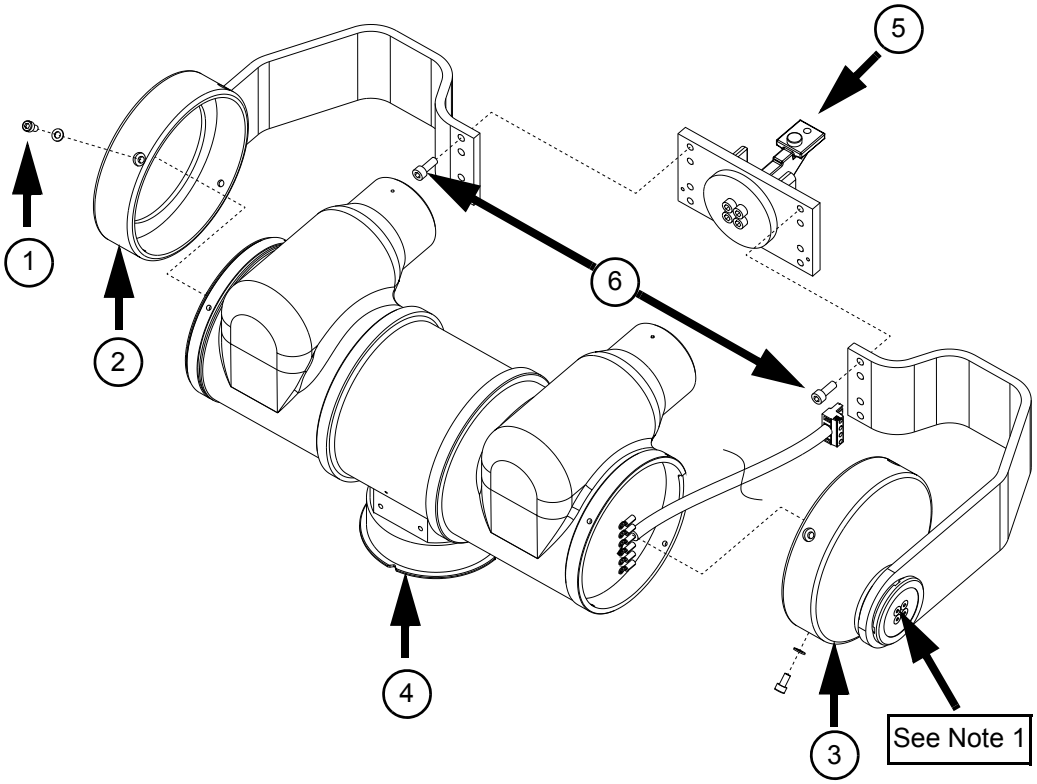


Item	Description
1	Tube yoke mounting screws (3 used)
2	Horizontal arm
3	X-ray tube/yoke assembly

Figure 8-147 X-ray tube mount

7. Tip the front of the X-ray tube assembly upward and slide the assembly out of the horizontal arm. Set the assembly on the work surface.

8. See Figure 8-148. Remove the four end cap mounting screws (Item 1) from the anode end cap (Item 3).



NOTICE

Note 1: Do NOT loosen or disturb the screws in this location. These are non-servicable items and require specialized fixtures for proper assembly. This applies to both the cathode and anode sides.

Item	Description
1	End cap mounting screws (4 used on each end cap)
2	Cathode end cap and tube mount
3	Anode end cap and tube mount
4	X-ray tube
5	Yoke
6	Tube mount screws (4 used on each side) New version length = 20 mm (0.78 in.) - used in Step 12

Figure 8-148 X-ray tube mount

9. Remove the four tube mount screws (Item 6) from the yoke (Item 5).
10. Remove the anode end cap / tube mount assembly from the X-ray tube (Item 4).
11. Install the new end cap / tube mount assembly onto the X-ray tube.
12. Install and tighten the four tube mount screws (apply thread locker and torque to 13.2 N-m (9.7 lb-ft)) and the four end cap screws (apply thread locker and torque to 2.5 N-m (1.8 lb-ft)).

13. Tip the front of the X-ray tube assembly upward and slide the assembly into the horizontal arm.
14. Install the X-ray tube and yoke assembly. Apply thread locker (Loctite 271 or equivalent) and torque the 3 fasteners as follows;
    - Single top fastener = 26.8 N-m (19.9 lb-ft)
    - Two bottom fasteners = 13.3 N-m (9.8 lb-ft)
15. Route and connect the rotor cable to the generator.
16. Install the tube covers.
17. Install the collimator. Route and connect the collimator cable to the Thorax bulkhead J4 and J5 connectors and chassis ground.
18. Insert the HV cables into the X-ray tube HV wells and tighten the mounting rings. Make sure that the cable markings (Tube Anode or Tube Cathode) match up with the X-ray tube marking (Anode or Cathode). See Figure 8-21, Figure 8-22 and Figure 8-23 for cable routing at the rear of the X-ray tube, if necessary.
19. Replace the cable ties and secure the cable drape.

NOTICE

Examine the steel cables at the top of the column to ensure proper tension has been maintained prior to unlocking the vertical carriage. If the safety lock has been engaged, disengaging the vertical carriage lock can result in uncontrolled cable tension and/or equipment damage, resulting in column replacement. For details on releasing the safety lock, see Column Replacement, 8.6.2.3 Procedure on page 318.

20. Unlock the vertical carriage.
21. Install the column top cover.
22. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
23. Install the front covers.
24. Install the side covers.

8.6.6.4 Finalization

1. Perform the following functional checks:
    - Tube column and arm - see Tube column and arm on page 35
2. Perform the following HHS checks:
    - Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117
3. For Optima XR220amx and Optima XR200amx with Digital Upgrade:
    - Perform QAP - refer to the Installation Manual, Chapter 6 - Detector checks and QAP

8.6.7 Tube yoke assembly

8.6.7.1 Personnel requirements

Required persons: 1

Timing (min): 120

8.6.7.2 Preliminary requirements

8.6.7.2.1 Tools and test equipment

- Standard tool kit

8.6.7.2.2 Consumables

- Cable ties
- Loctite 271 (GE part# 46-170684P1) or equivalent
- HV Tube Grease (GE part# 46-125224P3, Silicon Grease) or equivalent

8.6.7.2.3 Replacement parts

Item: Tube yoke assembly

Quantity: 1

8.6.7.2.4 Safety

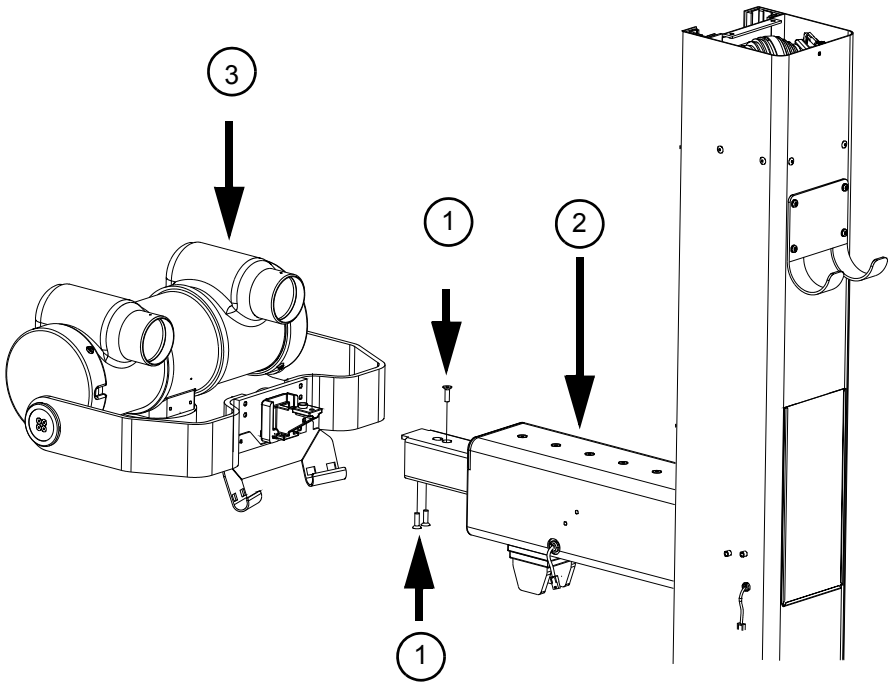
- The column vertical lock must be engaged before any weight (i.e. horizontal arm, X-ray tube, collimator) is removed from the vertical carriage.

8.6.7.2.5 Required conditions

- Remove the side covers and front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Remove the collimator. See 8.6.9 Collimator.
- Remove the tube covers. See 8.1.7 Tube head cover removal.

8.6.7.3 Procedure

1. Position the unit next to a work surface that can safely support the X-ray tube/yoke assembly.
2. Lock the vertical carriage. See 8.6.1 Engaging vertical lock.
3. Remove the collimator. See 8.6.9.1 Collimator replacement.
4. Remove the HV cables from the X-ray tube wells. Protect the HV cables to prevent damage.
5. Disconnect the rotor cable from the generator J6 connector, and free the rotor cable from the cable drape marking the location of the cable ties.
6. See Figure 8-149. Remove the three tube yoke mounting screws (Item 1) from the horizontal arm (Item 2).

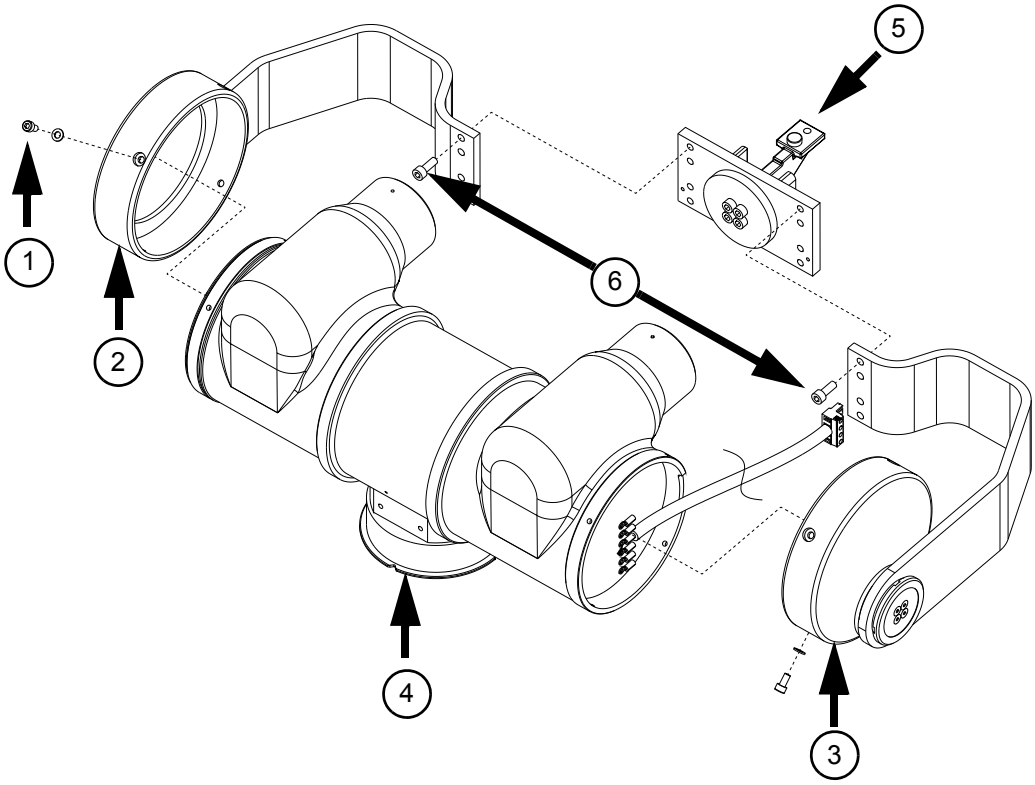


Item	Description
1	Tube yoke mounting screws (3 used)
2	Horizontal arm
3	X-ray tube/yoke assembly

Figure 8-149 X-ray tube mount

7. Tip the front of the X-ray tube assembly upward and slide the assembly out of the horizontal arm. Set the assembly on the work surface.

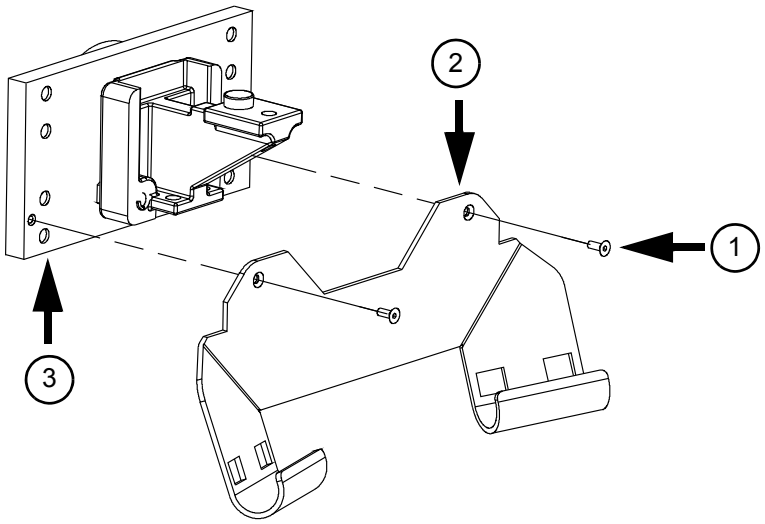
8. See Figure 8-150. Remove the eight tube mount screws (Item 6) from the yoke (Item 5).



Item	Description
1	End cap mounting screws (4 used on each end cap)
2	Cathode end cap and tube mount
3	Anode end cap and tube mount
4	X-ray tube
5	Yoke
6	Tube mount screws (4 used on each side)

Figure 8-150 X-ray tube mount

9. See Figure 8-151. Remove the mounting screws (Item 1) and cable bracket (Item 2) from the old yoke (Item 3) and install them on the new yoke. Torque to 0.8 N-m (0.6 lb-ft) - no thread locker is used.



Item	Description
1	Mounting screws
2	Cable bracket
3	Yoke

Figure 8-151 Yoke

10. Install the new yoke. Install and tighten the eight tube mount screws. Torque to 13.2 N-m (9.7 lb-ft) - no thread locker is used.
11. Tip the front of the X-ray tube assembly upward and slide the assembly into the horizontal arm.
12. Install the X-ray tube and yoke assembly. Apply thread locker (Loctite 271 or equivalent) and torque the 3 fasteners as follows;
    - Single top fastener = 26.8 N-m (19.9 lb-ft)
    - Two bottom fasteners = 13.3 N-m (9.8 lb-ft)
13. Route and connect the rotor cable to the generator.
14. Install the collimator. Route and connect the collimator cable to the Thorax bulkhead J4 and J5 connectors and chassis ground.
15. Insert the HV cables into the X-ray tube HV wells and tighten the mounting rings. Make sure that the cable markings (Tube Anode or Tube Cathode) match up with the X-ray tube marking (Anode or Cathode). See Figure 8-21, Figure 8-22 and Figure 8-23 for cable routing at the rear of the X-ray tube, if necessary.
16. Replace the cable ties and secure the cable drape.

NOTICE

Examine the steel cables at the top of the column to ensure proper tension has been maintained prior to unlocking the vertical carriage. If the safety lock has been engaged, disengaging the vertical carriage lock can result in uncontrolled cable tension and/or equipment damage, resulting in

column replacement. For details on releasing the safety lock, see Column Replacement, 8.6.2.3 Procedure on page 318.

17. Unlock the vertical carriage.
18. Install the column top cover.
19. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
20. Install the front covers.
21. Install the side covers.

8.6.7.4 Finalization

1. Perform the following HHS checks:
   - Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117
2. For Optima XR220amx and Optima XR200amx with Digital Upgrade:
   - Perform QAP - refer to the Installation Manual, Chapter 6 - Detector checks and QAP

8.6.8 Toshiba X-ray tube

8.6.8.1 Personnel requirements

Required persons: 1

Timing (min): 6 hrs

8.6.8.2 Preliminary requirements

8.6.8.2.1 Tools and test equipment

- Standard tool kit

8.6.8.2.2 Consumables

- Loctite 271 (GE part# 46-170684P1) or equivalent
- HV Tube Grease (GE part# 46-125224P3, Silicon Grease) or equivalent

8.6.8.2.3 Replacement parts

Item: Toshiba X-ray tube

Quantity: 1

8.6.8.2.4 Safety

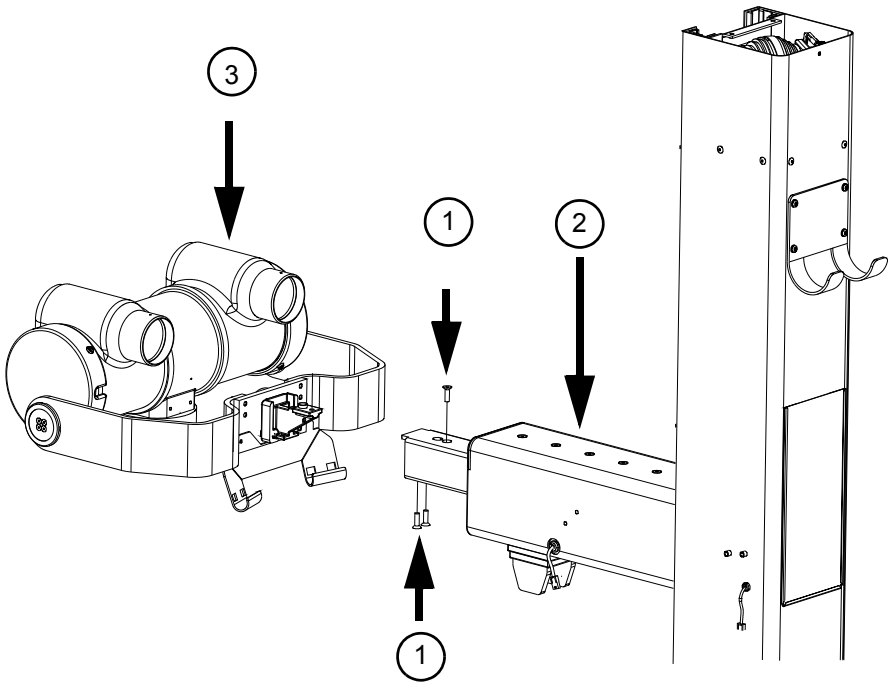
- The column vertical lock must be engaged before any weight (i.e. horizontal arm, X-ray tube, collimator) is removed from the vertical carriage.

8.6.8.2.5 Required conditions

- Remove the side covers and front covers. See 8.1.3 Front cover removal.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Remove the collimator. See 8.6.9 Collimator.
- Remove the tube covers. See 8.1.7 Tube head cover removal.

8.6.8.3 Procedure

1. Position the unit next to a work surface that can safely support the X-ray tube/yoke assembly.
2. Lock the vertical carriage. See 8.6.1 Engaging vertical lock.
3. Remove the collimator. See 8.6.9.1 Collimator replacement.
4. Remove the HV cables from the X-ray tube wells. Protect the HV cables to prevent damage.
5. Disconnect the rotor cable from the generator J6 connector, and free the rotor cable from the cable drape marking the location of the cable ties.
6. See Figure 8-152. Remove the three tube yoke mounting screws (Item 1) from the horizontal arm (Item 2).

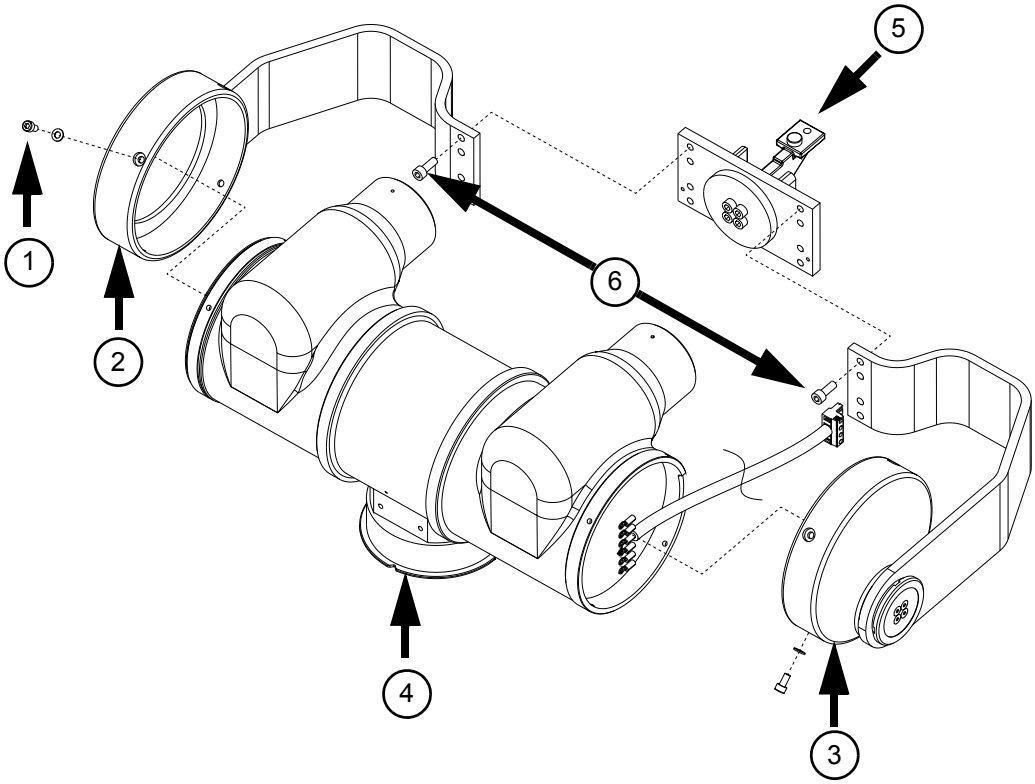


Item	Description
1	Tube yoke mounting screws (3 used)
2	Horizontal arm
3	X-ray tube/yoke assembly

Figure 8-152 X-ray tube mount

7. Tip the front of the X-ray tube assembly upward and slide the assembly out of the horizontal arm. Set the assembly on the work surface.

8. See Figure 8-153. Remove the four end cap mounting screws (Item 1) from the cathode end cap (Item 2).



Item	Description
1	End cap mounting screws (4 used on each end cap)
2	Cathode end cap and tube mount
3	Anode end cap and tube mount
4	X-ray tube
5	Yoke
6	Tube mount screws (4 used on each side)

Figure 8-153 X-ray tube mount

9. Remove the four cathode-side tube mount screws (Item 6) from the yoke (Item 5).
10. Remove the cathode end cap / tube mount assembly from the X-ray tube (Item 4).
11. Remove the four end cap mounting screws (Item 1) from the anode end cap (Item 3).
12. Remove the anode end cap / tube mount / yoke assembly from the X-ray tube (Item 4).
13. Use a HV spanner wrench (see Figure 8-154) to loosen and remove the HV cable tightening rings, then remove the cables from the HV wells.

Figure 8-154 HV cable spanner wrench

14. Disconnect the stator wires from the old X-ray tube.

15. Connect the stator wires to the new X-ray tube.

Note: HV cables must be lubricated with silicone **grease** (GE P/N 46-125224P3 or equivalent) before insertion into the **X-ray tube HV wells**. The grease is shipped with the X-ray tube.

16. Insert the HV cables into the new X-ray tube HV wells and tighten the mounting rings. Make sure that the cable markings (Tube Anode or Tube Cathode) match up with the X-ray tube marking (Anode or Cathode). See Figure 8-21, Figure 8-22 and Figure 8-23 for cable routing at the rear of the X-ray tube, if necessary.
17. Install the anode end cap / tube mount assembly on the X-ray tube. Install and tighten the four end cap mounting screws (apply thread locker and torque to 2.5 N-m (1.8 lb-ft)) and the four tube mount screws (torque to 13.2 N-m (9.7 lb-ft) - no thread locker is used).
18. Install the cathode end cap / tube mount assembly on the X-ray tube. Install and tighten the four end cap mounting screws (apply thread locker and torque to 2.5 N-m (1.8 lb-ft) and the four tube mount screws (torque to 13.2 N-m (9.7 lb-ft) - no thread locker is used).
19. Tip the front of the X-ray tube assembly upward and slide the assembly into the horizontal arm.
20. Install the X-ray tube and yoke assembly. Apply thread locker (Loctite 271 or equivalent) and torque the 3 fasteners as follows;
    - Single top fastener = 26.8 N-m (19.9 lb-ft)
    - Two bottom fasteners = 13.3 N-m (9.8 lb-ft)
21. Route and connect the rotor cable to the generator.
22. Install the collimator. Route and connect the collimator cable to the Thorax bulkhead J4 and J5 connectors and chassis ground.
23. Replace the cable ties and secure the cable drape.

NOTICE

Examine the steel cables at the top of the column to ensure proper tension has been maintained prior to unlocking the vertical carriage. If the safety lock has been engaged, disengaging the vertical carriage lock can result in uncontrolled cable tension and/or equipment damage, resulting in column replacement. For details on releasing the safety lock, see Column Replacement, 8.6.2.3 Procedure on page 318.

24. Unlock the vertical carriage.
25. Install the column top cover.
26. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
27. Install the front covers.
28. Install the side covers.

8.6.8.4 Finalization

1. Perform the following calibrations:
    - Filament - see 5.3.1 Setting filament drive level on page 90
2. Perform the following HHS checks:
    - Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117
    - Half-value layer - see Table 7-17 Beam quality data (half value layer) on page 130
    - kV accuracy - see 7.1.4.2 Testing kVp accuracy on page 122
    - mAs Accuracy - see 7.1.4.3 Testing mAs accuracy on page 124

- Reproducability - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127
- Linearity - see 7.1.4.4 Testing reproducibility and linearity of exposure on page 127

3. For Optima XR220amx and Optima XR200amx with Digital Upgrade:
   - Perform QAP - refer to the Installation Manual, Chapter 6 - Detector checks and QAP

8.6.9 Collimator

8.6.9.1 Collimator replacement

8.6.9.1.1 Personnel requirements

Required persons: 1

Timing (min): 60

8.6.9.1.2 Preliminary requirements

8.6.9.1.3 Tools and test equipment

- Standard tool kit
- One Hexagon Wrench for M3 screws

8.6.9.1.4 Consumables

- Cable ties

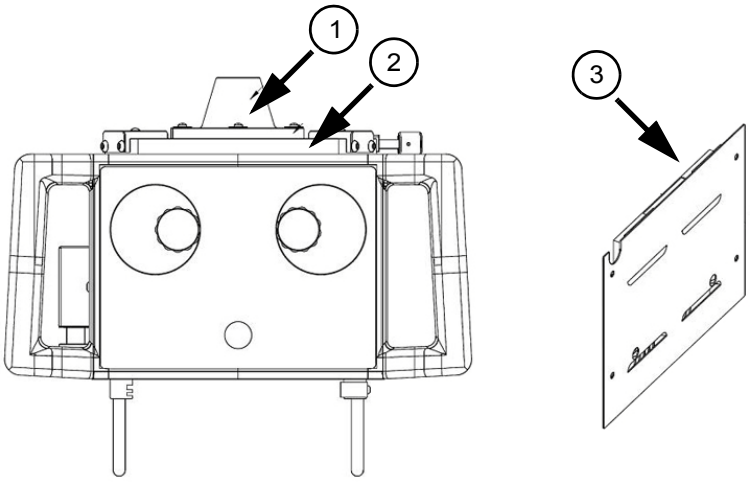
8.6.9.1.5 Replacement parts

Item: Collimator

Quantity: 1

8.6.9.1.6 Safety

- The column vertical lock must be engaged before any weight (i.e. horizontal arm, X-ray tube, collimator) is removed from the vertical carriage.
- Lead Locations. See Figure 8-155.



Item	Description
1	Lead cone
2	Filter
3	Rear cover - lead plate pasted inside

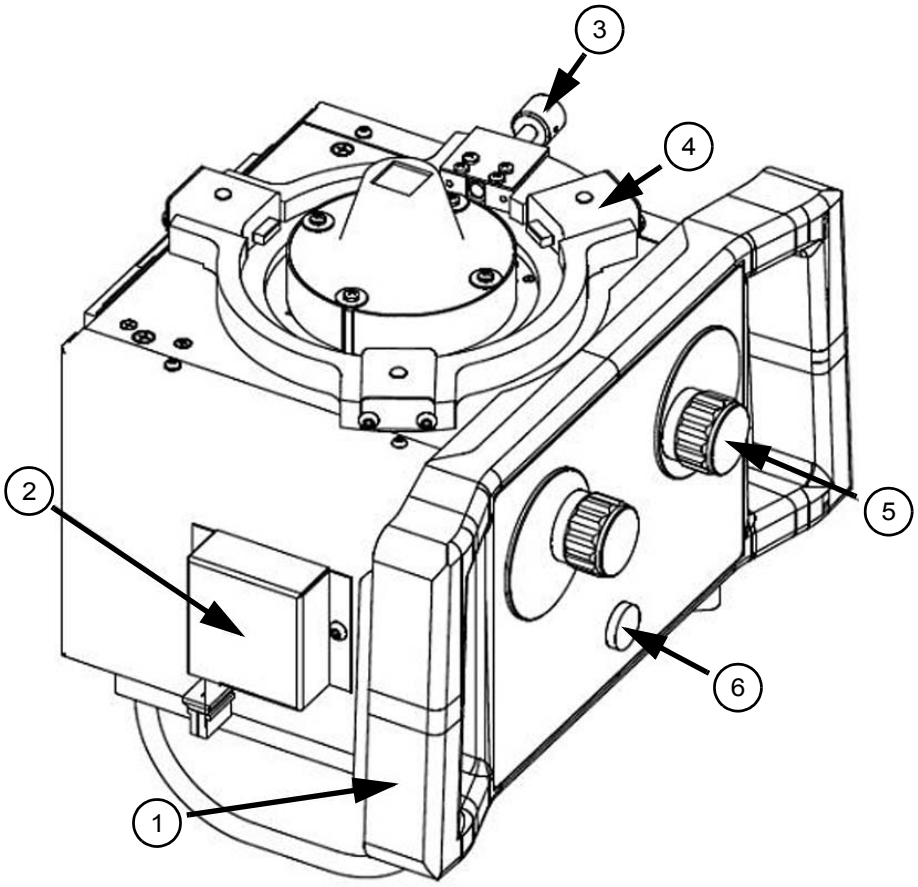
Figure 8-155 Lead locations

8.6.9.1.7 Required conditions

- Remove the side covers, front covers and front bin. See 8.1.4 Front bin removal on page 156.
- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.6.9.1.8 Procedure

See Figure 8-156. Collimator dismounting consists of disconnecting the collimator cable, opening the back covers of the suspending lock sets, unlocking the suspending lock sets, pulling out the rotation lock finger and lifting the collimator off of the interface ring.



Item	Description
1	Handle
2	SID tape
3	Rotation lock handle
4	Suspending lock set (3 used)
5	Knob
6	Lamp switch

Figure 8-156 Installation and removal

1. Lock the vertical carriage. See 8.6.1 Engaging vertical lock.

2. See Figure 8-157. Disconnect the collimator cable from the Thorax bulkhead (J4, J5 and ground).

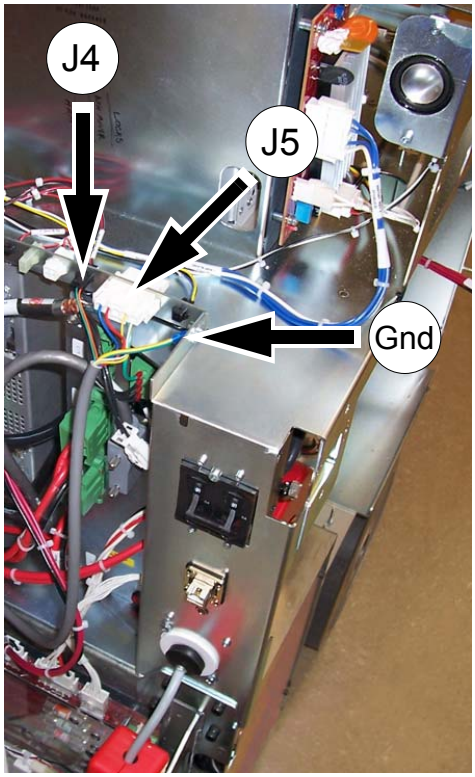
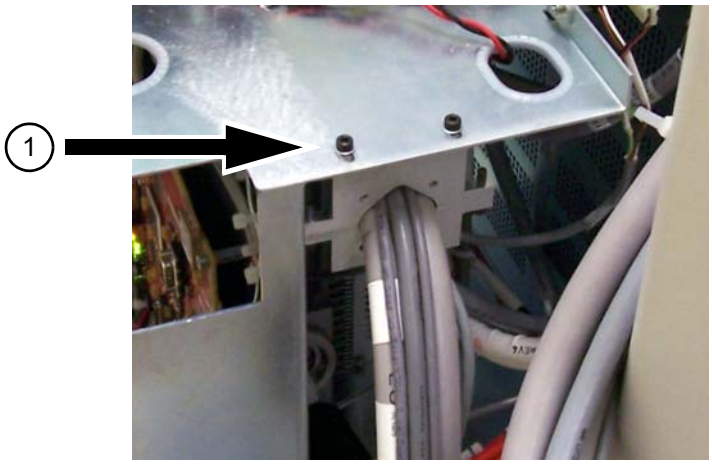


Figure 8-157 Collimator cable - Thorax bulkhead J4, J5, Gnd

3. Remove the HV cable clamp mounting screws. See Figure 8-158.



Item	Description
1	HV cable clamp mounting screws (2)

Figure 8-158 HV cable clamp mounting screws

4. Remove the clamp from the HV cable bundle. See Figure 8-159.

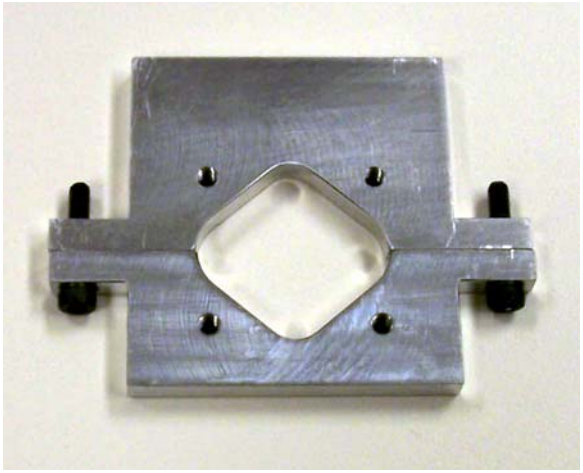
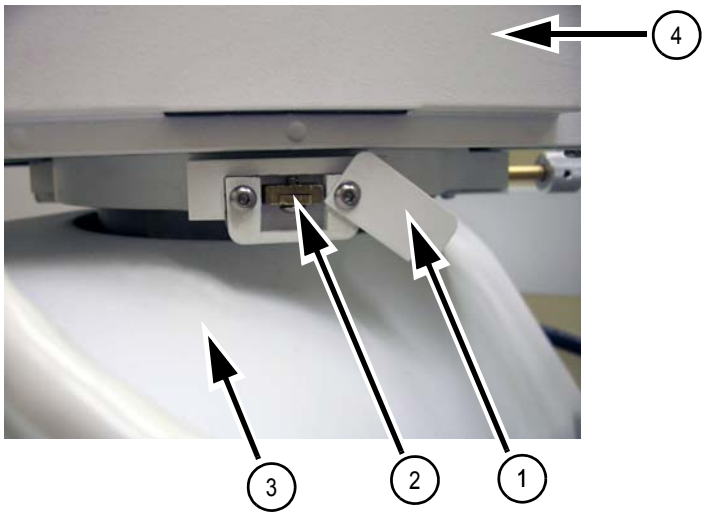


Figure 8-159 HV cable clamp

5. Follow the collimator cable back through the cable drape. At each existing cable tie, mark the location of the cable tie on an adjacent cable, then cut and remove the cable tie.
6. Rotate the X-ray tube/collimator assembly 180 degrees (the bottom of the collimator faces upward).

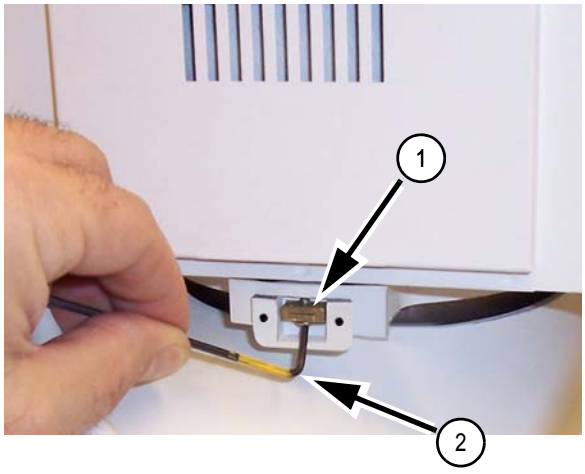
7. See Figure 8-160. Use a hex wrench to remove the screws and the back cover (Item 1) of the suspending lock set. Repeat this step on all three back covers.



Item	Description
1	Suspending lock set cover
2	Suspending lock finger
3	X-ray tube
4	Collimator

Figure 8-160 Suspending lock

8. See Figure 8-161. Pull out the three suspending lock fingers (Item 1). Use a small allen wrench (Item 2) to hook the center of the lock finger screw and pull it straight outward until it locks into the extended position.



Item	Description
1	Suspending lock finger
2	Allen wench

Figure 8-161 Suspending lock

9. Rotate the handle of the rotation lock set counterclockwise until the lock finger cannot be rotated any more.

⚠ CAUTION

LEAD HAZARD

- Do not touch lead cone or filter by hand without gloves.
- Do not let the lead cone touch anything during the collimator installation and removal process.

10. Carefully lift the old collimator off of the X-ray tube and set it aside.
11. On the new collimator:
    a. Close the collimator blades.
    b. Rotate the handle of the rotation lock set counterclockwise until the lock finger cannot be rotated any more.
    c. Open the suspending lock set covers and pull out the three lock fingers until they lock in the extended position
    d. Lift the collimator by holding the handle, then rotate the collimator 180 degrees so that the lead cone is facing downward and its axis is perpendicular to tube flange's mounting surface.
12. Put the collimator on the tube. Make sure the lead cone does not touch the tube flange during this step.
13. Press the three buttons on the top of the three suspending lock sets to let the lock fingers pop out.

⚠ CAUTION

DROP HAZARD
MAKE SURE THERE IS NO RED COLOR VISIBLE AT THE BACK OF EACH SUSPENDING LOCK SET AFTER PRESSING THE SUSPENDING LOCK BUTTONS.

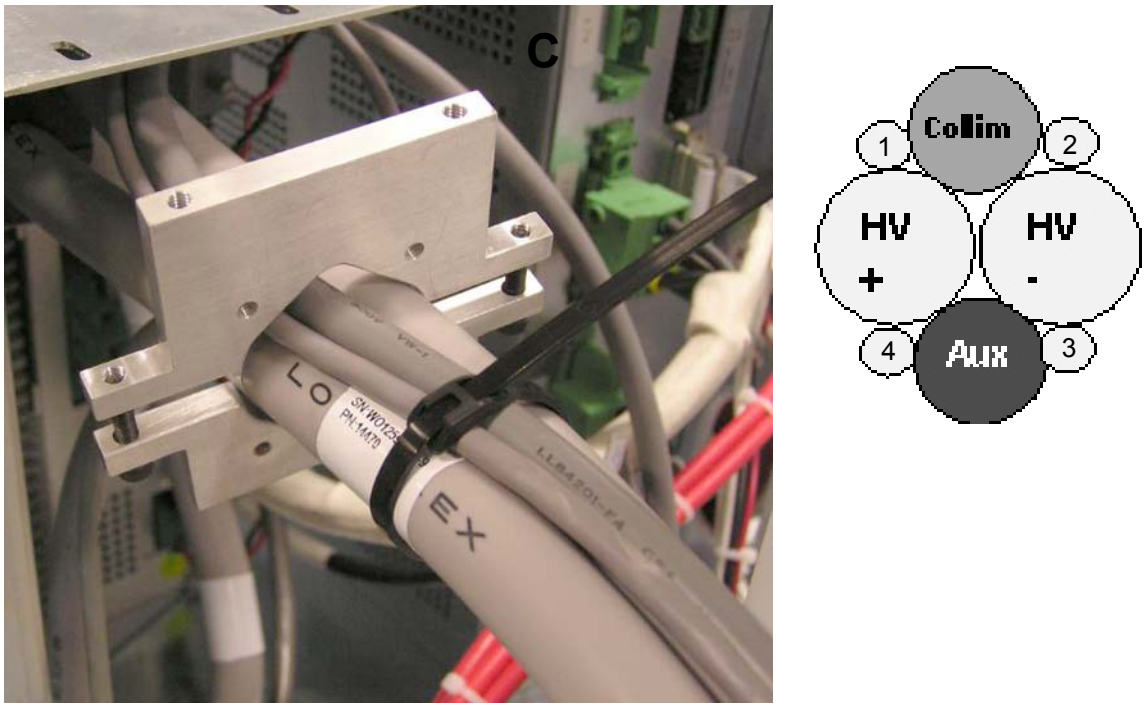
14. Install the three suspending lock set covers and six screws (the collimator can be rotated so that the suspending lock set is oriented towards the rear of the X-ray tube; this will make it easier to install the screws and covers).
15. Turn the handle of the rotation lock set until the black line on the handle shaft aligns to the back surface of the rotation lock set.
16. Check the installation thoroughly for correct and safe mounting.

NOTICE

Examine the steel cables at the top of the column to ensure proper tension has been maintained prior to unlocking the vertical carriage. If the safety lock has been engaged, disengaging the vertical carriage lock can result in uncontrolled cable tension and/or equipment damage, resulting in column replacement. For details on releasing the safety lock, see Column Replacement, 8.6.2.3 Procedure on page 318.

17. Rotate the X-ray tube/collimator assembly back to the normal position.
18. Mark the collimator cable 400 mm (~16 in.) from the body of the collimator. Position the cable so the mark lines up with the cable support bracket and install a cable tie.

19. Route the collimator back through the cable drape to the Thorax bulkhead, attaching cable ties at the marks placed in Step 5 above.
20. Plug the collimator cable into J4 and J5 on the Thorax bulkhead and attach the ground wire to the chassis.
21. Arrange the cable bundle as shown in Figure 8-162, use a cable tie to maintain cable positions.
22. Install the clamp onto the cable bundle. DO NOT TIGHTEN THE CLAMP YET.
23. Mount the clamp to the Thorax chassis. Slide the clamp to the rear of the mounting screw slots.
24. Tighten the clamp around the cable bundle, ensuring that the cables are not pinched by the clamp.



Item	Description
1	DAP cable (optional for Optima XR200amx systems)
2	Wireless cable (only valid for Optima XR220amx systems)
3	Vertical brake cable
4	Horizontal arm lock cable

Figure 8-162 Correct cable bundle arrangement

25. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.
26. Install the front bin.
27. Install the front covers.
28. Install the side covers.
29. Package the old collimator for return.

8.6.9.2 Finalization

1. Perform the following calibrations:
   - Lamp (if HHS tests fail) - see 8.6.14 Collimator lamp on page 373
2. Perform the following HHS checks:
   - Field size indicator accuracy - see 7.1.3.3 Testing field size indicator accuracy (Optima XR200amx) on page 120 or 7.1.3.4 Testing field size indicator accuracy (Optima XR220amx or Optima XR200amx with digital upgrade) on page 121
   - Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117
   - Half-value layer - see 7.1.5.1 Measuring half value layer (HVL) on page 129
3. For Optima XR220amx and Optima XR200amx with Digital Upgrade:
   - Perform QAP - refer to the Installation Manual, Chapter 6 - Detector checks and QAP

8.6.10 Dose Area Product (DAP) meter

8.6.10.1 Personnel requirements

Required persons: 1

Timing (min): 10

8.6.10.2 Preliminary requirements

8.6.10.2.1 Tools and test equipment

- Standard tool kit

8.6.10.2.2 Consumables

- None

8.6.10.2.3 Replacement parts

Item: DAP meter

Quantity: 1

8.6.10.2.4 Safety

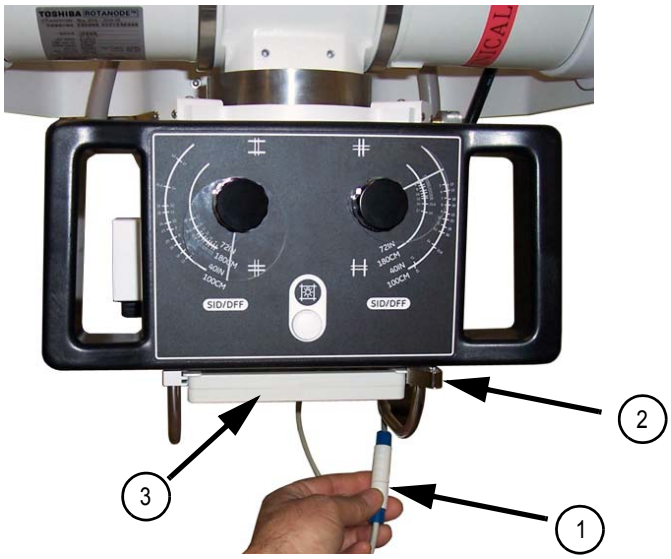
- None

8.6.10.2.5 Required conditions

- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.6.10.3 Procedure

1. See Figure 8-163. Disconnect the DAP cable connector (Item 1).



Item	Description
1	DAP cable connector
2	Latch
3	DAP meter

Figure 8-163 DAP

2. Release the latch (Item 2) and slide the DAP (Item 3) out of the collimator rails.
3. Install the new DAP into the collimator rails and push backwards until the latch engages.
4. Connect the DAP cable.
5. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.

NOTICE

NOTICE: The system must be reset using the power button each time the DAP meter is disconnected and then reconnected with system power on. The DAP meter does not support "Hot Swapping". Failure to reset the system in this occurrence can result in an inaccurate dose value reported by the DAP meter.

8.6.10.4 Finalization

1. Perform DAP calibration - see 5.6.3 DAP calibration on page 94.
2. Perform the following functional checks:
   - X-ray - Dose report - see X-ray on page 36
3. Perform the following HHS checks:
   - Light field intensity - see 7.1.3.1 Testing light intensity on page 116

8.6.11 SID tape measure

8.6.11.1 Personnel requirements

Required persons: 1
Timing (min): 10

8.6.11.2 Preliminary requirements

8.6.11.2.1 Tools and test equipment

- Standard tool kit

8.6.11.2.2 Consumables

- Loctite 242 (GE part# 46-170686P2) or equivalent

8.6.11.2.3 Replacement parts

Item: SID tape measure
Quantity: 1

8.6.11.2.4 Safety

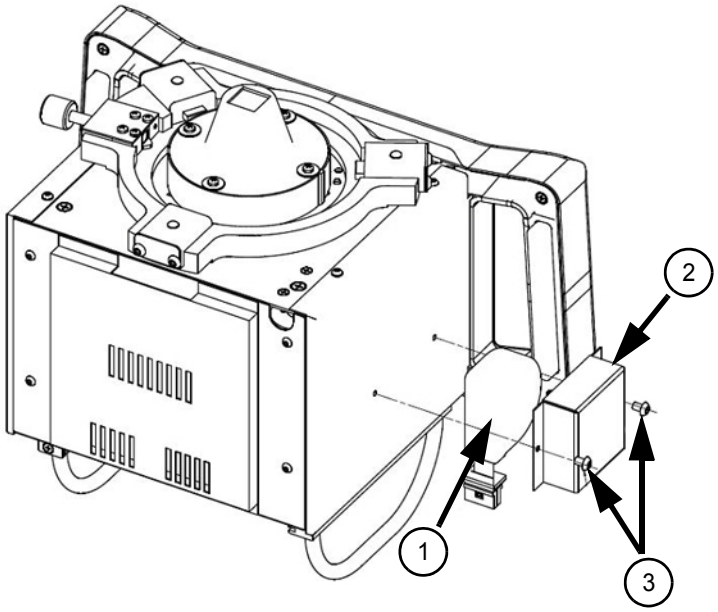
- None

8.6.11.2.5 Required conditions

- None

8.6.11.3 Procedure

1. Remove the two screws and remove the tape cover. See Figure 8-164.



Item	Description
1	Tape
2	Tape cover
3	Tape cover screws

Figure 8-164 SID tape measure replacement

2. Take the tape out of the tape cover.
3. Put a new tape into the tape cover.
4. Mount the tape cover and tighten the two screws with thread locker.

8.6.11.4 Finalization

None

8.6.12 Collimator adjustment knob

8.6.12.1 Personnel requirements

Required persons: 1

Timing (min): 10

8.6.12.2 Preliminary requirements

8.6.12.2.1 Tools and test equipment

- Standard tool kit

8.6.12.2.2 Consumables

- Loctite 242 (GE part# 46-170686P2) or equivalent

8.6.12.2.3 Replacement parts

Item: Collimator adjustment knob

Quantity: 1 (kit contains parts for one knob assembly)

8.6.12.2.4 Safety

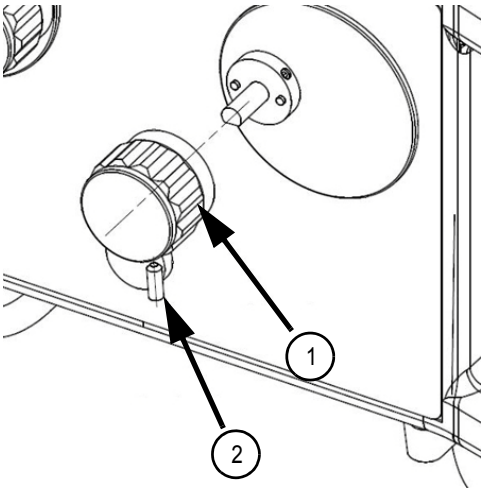
- None

8.6.12.2.5 Required conditions

- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.6.12.3 Procedure

1. Loosen the setscrew and remove the knob from the shaft. See Figure 8-165.



Item	Description
1	Knob
2	Set screw

Figure 8-165 Knob replacement

2. Put the new knob onto the knob shaft.
3. Ensure that the knob is up against the indicator tightly, and tighten the setscrew with thread locker (i.e. Loctite 242 [blue]).
4. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.

8.6.12.4 Finalization

Perform the following HHS checks:

- Field size indicator accuracy - see 7.1.3.3 Testing field size indicator accuracy (Optima XR200amx) on page 120 or 7.1.3.4 Testing field size indicator accuracy (Optima XR220amx or Optima XR200amx with digital upgrade) on page 121
- Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117

8.6.13 Collimator pointer

8.6.13.1 Personnel requirements

Required persons: 1

Timing (min): 20

8.6.13.2 Preliminary requirements

8.6.13.2.1 Tools and test equipment

- Standard tool kit
- 2 triangular stickers
- 1 piece of paper

8.6.13.2.2 Consumables

- Loctite 242 (GE part# 46-170686P2) or equivalent

8.6.13.2.3 Replacement parts

Item: Collimator pointer

Quantity: 1 (kit contains parts for one knob assembly)

8.6.13.2.4 Safety

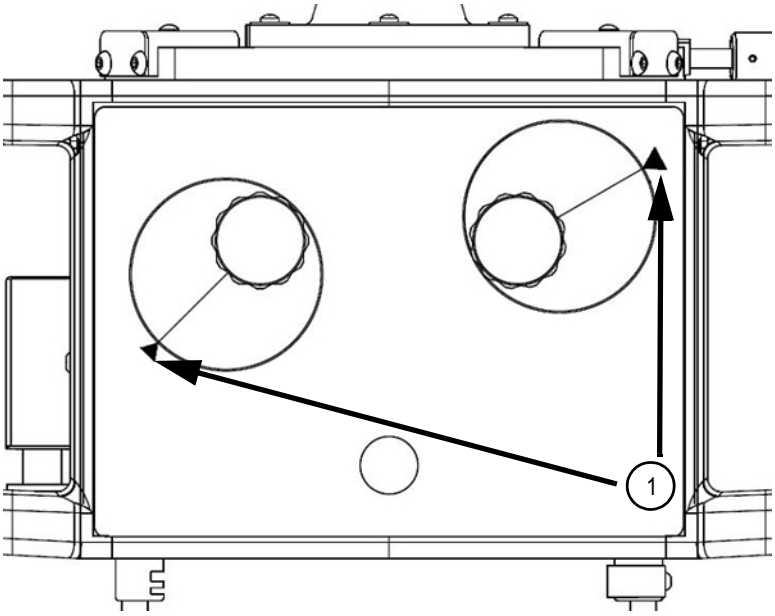
- None

8.6.13.2.5 Required conditions

- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

8.6.13.3 Procedure

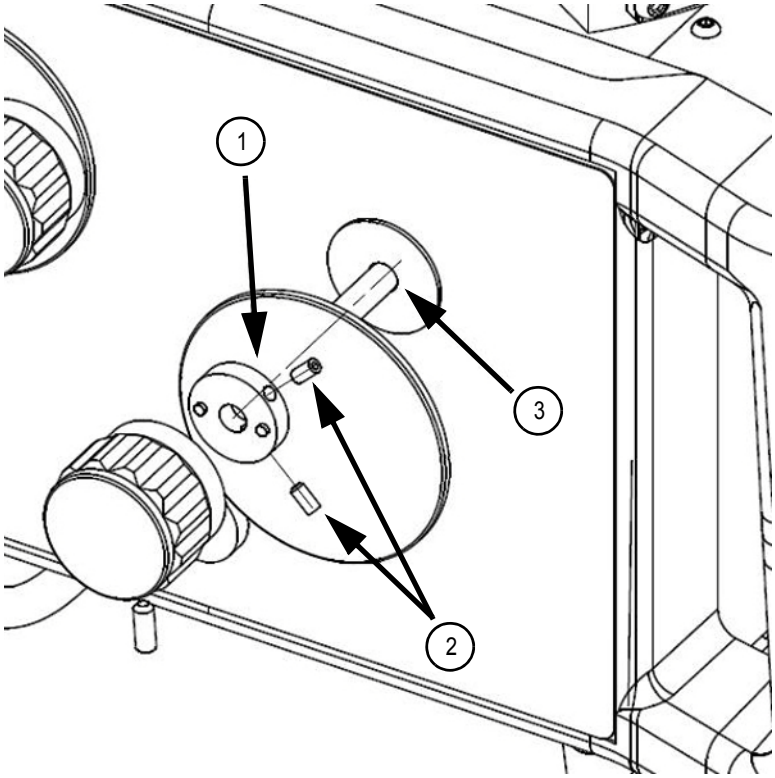
1. Turn the knob counterclockwise until it cannot be rotated any more.
2. Attach a triangle sticker on the front cover and make one of its vertexes align with the indicator line. See Figure 8-166.



Item	Description
1	Attach temporary position markers here

Figure 8-166 Paste symbols to replace the indicator plate kit

3. Remove the knob (refer to 8.6.12.3 Procedure on page 369).
4. Loosen two setscrews to remove the indicator plate kit from the knob shaft. See Figure 8-167.



Item	Description
1	Indicator plate kit
2	Set screws
3	Knob washer

Figure 8-167 Indicator plate kit replacement

5. Insert a paper between the knob washer and front cover.
6. Loosen the setscrews on the new indicator plate kit and mount it onto the knob shaft.
7. Press the indicator plate kit to the knob washer, and let the indicator point to the paste symbol's vertex.
8. Tighten the setscrews.

Note: **Ensure both setscrews have been tightened before proceeding to the next step.**

9. Mount the knob. See 8.6.12 Collimator adjustment knob.
10. Rotate the knob to ensure it can rotate smoothly.
11. Verify the field size indicator accuracy. See 7.1.3.3 Testing field size indicator accuracy (Optima XR200amx) on page 120 or 7.1.3.4 Testing field size indicator accuracy (Optima XR220amx or Optima XR200amx with digital upgrade) on page 121.
12. Remove the paper between the knob washer and the front cover.
13. Remove the triangle pasted on the front cover.
14. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.

8.6.13.4 Finalization

Perform the following HHS checks:

- Field size indicator accuracy - see 7.1.3.3 Testing field size indicator accuracy (Optima XR200amx) on page 120 or 7.1.3.4 Testing field size indicator accuracy (Optima XR220amx or Optima XR200amx with digital upgrade) on page 121
- Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117

8.6.14 Collimator lamp

8.6.14.1 Personnel requirements

Required persons: 1

Timing (min): 30

8.6.14.2 Preliminary requirements

8.6.14.2.1 Tools and test equipment

- Standard tool kit

8.6.14.2.2 Consumables

- Loctite 242 (GE part# 46-170686P2) or equivalent

8.6.14.2.3 Replacement parts

Item: Collimator lamp

Quantity: 1

8.6.14.2.4 Safety

- None

8.6.14.2.5 Required conditions

- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.

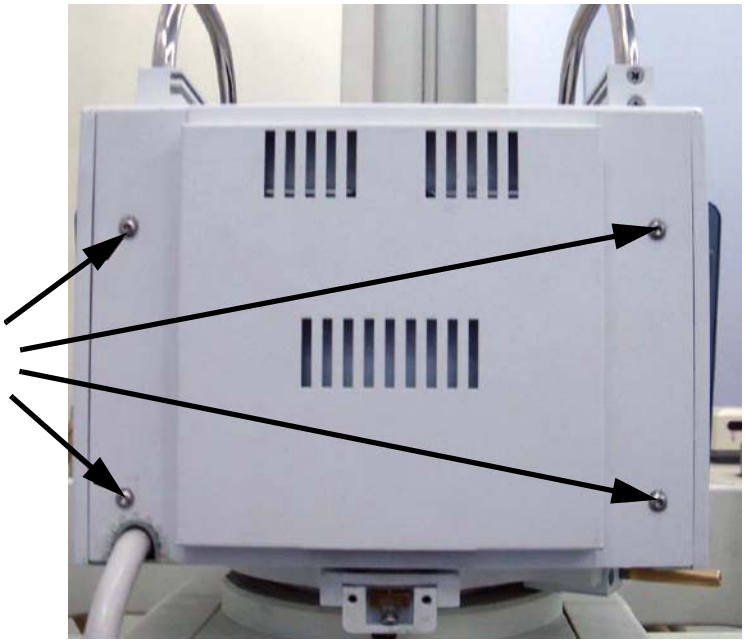
8.6.14.3 Procedure

1. Rotate the tube and make the tube flange's axis perpendicular to the ground with the bottom of the collimator facing upward.

CAUTION

LEAD HAZARD
Do not touch the interior of the rear collimator cover without gloves.

2. Remove the four screws on the rear collimator cover, then remove the cover. See Figure 8-168.



Item	Description
1	Screws

Figure 8-168 Rear cover removal

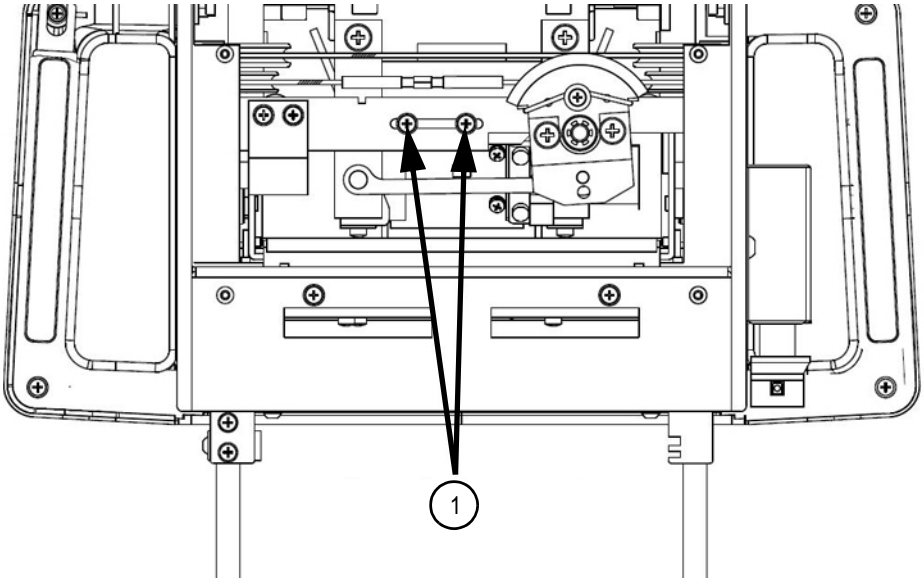
3. Unplug the defective collimator lamp.
4. Make sure the screws which hold the lamp mask are tight.

NOTICE

POTENTIAL DAMAGE TO LAMP
When holding the new lamp, operator must wear clean cotton gloves.

5. Insert a new lamp in the lamp socket.
6. Make sure the filament of the new lamp is in the middle of the window on the lamp mask at lateral orientation.
7. Mount the rear cover of the collimator and tighten the screws.

8. Turn the rotation lock handle until the black line on the handle shaft aligns to the back surface of the rotation lock set.
9. Rotate the collimator to the desired position.
10. Verify if there is misalignment (refer to 7.1.3.2 Testing light field to X-ray field alignment on page 117).
    If there is misalignment in the N-S (lateral) orientation, then:
    * Ensure the lamp position is according to the requirement of step 6 above.
    * If the lamp position is correct, adjust the lamp support by loosening the screws. See Figure 8-169.



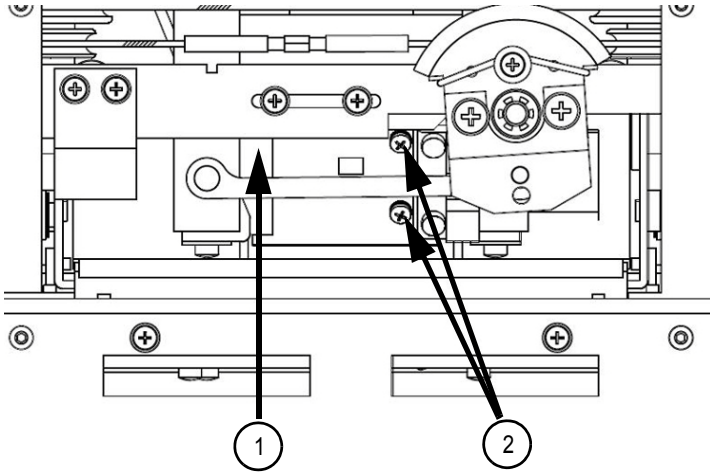
Item	Description
1	Adjustment screws

Figure 8-169 Lamp support adjustment

If there is misalignment in E-W (longitudinal) orientation, then:

* Ensure the lamp position is according to the requirement of step 4 above.

* If the screws are not loosened, adjust the lamp mask by loosening the screws, then adjust orientation. See Figure 8-170.



Item	Description
1	Adjust orientation
2	Screws for lamp mask

Figure 8-170 Lamp mask adjustment

11. Darken the exam room and check if the light field intensity fulfills the specification (refer to 7.1.3.1 Testing light intensity on page 116).
12. If the light field intensity does not fulfill the specification, remove the rear cover, and:
13. Check that the voltage at the collimator lamp is between 20 and 22 VDC.
14. Ensure the lamp position is according to the requirement of step 6.
15. If the lamp position is right, adjust the lamp mask to make it shade the filament smaller than original position.
16. Repeat steps 10 through 15 above until misalignment and light intensity can both meet the criteria of acceptance.
17. Apply thread locker (i.e. Loctite 242 [blue]) to the rear cover screws. Install the rear cover and tighten the screws.
18. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29

8.6.14.4 Finalization

1. Perform the following calibrations:
   - Adjust the collimator lamp supply potentiometer R3 so that the voltage at the collimator lamp is 20.0 - 22.0 VDC.
2. Perform the following HHS checks:
   - Field size indicator accuracy - see 7.1.3.3 Testing field size indicator accuracy (Optima XR200amx) on page 120 or 7.1.3.4 Testing field size indicator accuracy (Optima XR220amx or Optima XR200amx with digital upgrade) on page 121
   - Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117

8.6.15 Collimator rotation lock finger

8.6.15.1 Personnel requirements

Required persons: 1

Timing (min): 20

8.6.15.2 Preliminary requirements

8.6.15.2.1 Tools and test equipment

- Standard tool kit

8.6.15.2.2 Consumables

- Cable ties

8.6.15.2.3 Replacement parts

Item: Collimator rotation lock finger

Quantity: 1

8.6.15.2.4 Safety

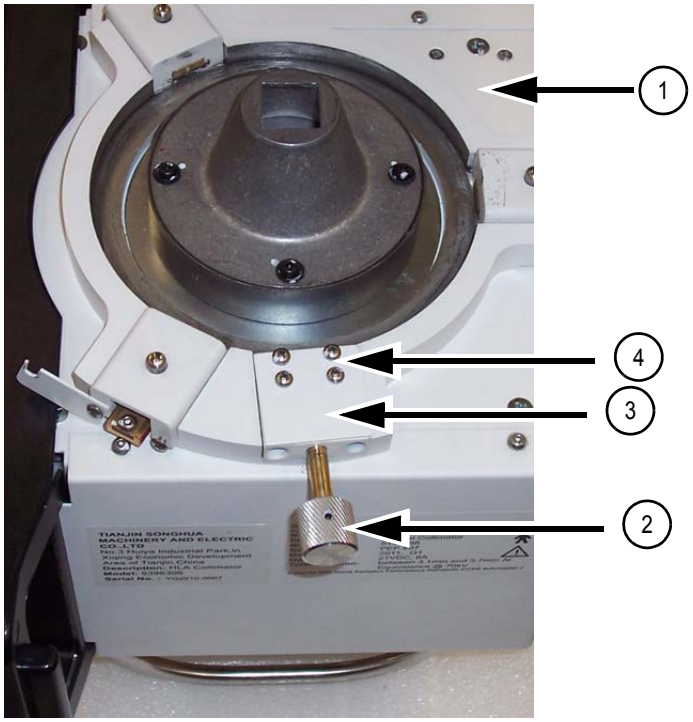
- None

8.6.15.2.5 Required conditions

- Perform LOTO on the system. See 1.2.2 Performing LOTO on page 26.
- Remove the collimator from the X-ray tube. See 8.6.9.1 Collimator replacement.

8.6.15.3 Procedure

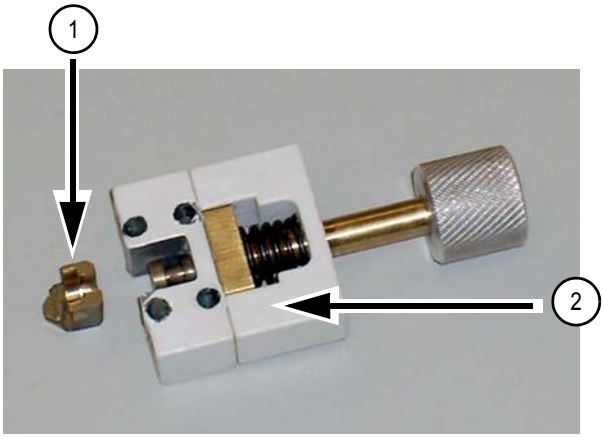
1. See Figure 8-171. Remove the four mounting screws (Item 4) and the rotation lock cover (Item 3).



Item	Description
1	Collimator
2	Rotation lock knob
3	Rotation lock cover
4	Rotation lock cover screws

Figure 8-171 Rotation lock

2. See Figure 8-172. Remove the rotation lock assembly (Item 2) from the collimator.
3. Remove the rotation lock finger (Item 1) from the rotation lock assembly (Item 2). Slightly rotating the lock knob will make it easier to remove the lock finger.



Item	Description
1	Rotation lock finger
2	Rotation lock assembly

Figure 8-172 Rotation lock finger assembly

4. Install the new lock finger. The wider end of the lock finger should be on the bottom, as shown in Figure 8-172.
5. Install the rotation lock assembly and mounting screws on the collimator.
6. Install the collimator on the X-ray tube. See 8.6.9.1 Collimator replacement.
7. Remove LOTO from the system. See 1.2.3 Returning system to service on page 29.

8.6.15.4 Finalization

1. Perform the following functional checks:
   - Collimator (the 3 detent and 1 collimator rotation checks) - see Tube column and arm on page 35
2. Perform the following HHS checks:
   - Light field to X-ray field alignment - see 7.1.3.2 Testing light field to X-ray field alignment on page 117
3. For Optima XR220amx and Optima XR200amx with Digital Upgrade:
   - Perform QAP - refer to the Installation Manual, Chapter 6 - Detector checks and QAP

Appendix A Printer Configuration Information

Section A.1 Agfa Drystar 3000 printer parameters

Table A-1 Agfa Drystar 3000 printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	DRYSTAR3000	Or customers preference
	Application Entry Title	Enter value given by site network administrator	AE titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	104	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	79.4	
	Configuration Information	PERCEPTION_LUT=LINEAR (no spaces)	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	140	
	Trim	NO	Not supported
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	40Mbyte	
Layouts	Select the desired layouts allowed for this printer	1:1, 1:2, 2:1, 2:2	
	Slide formats	Not applicable	Not supported; do not select

Table A-1 Agfa Drystar 3000 printer configuration information

Tab	Attribute	Value	Comments
Film Sizes	8 x 10in	Pixel width = 2388 Pixel height = 2972	Agfa layout - portrait 9006
	10 x 12in	Pixel width = Pixel height =	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = 3300 Pixel height = 4256	Agfa layout - portrait 9014
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = 4256 Pixel height = 5174	Agfa layout - portrait 2411
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Agfa Drystar 3000 general comments

Supports clear and blue film. If medium selected (clear, paper) does not match the printer, the job will be queued until the correct film is loaded.

Agfa layouts are specific to maximum printable area layouts. Consult the Agfa technical representative to install custom layouts.

Only 14x17 film was tested with this printer.

Trim is not supported by this printer.

Note: Avoid print job failures by having printer vendor ensure that the Confirmation Level (DICOM Connectivity) at the printer is set to Ø (accept all). Failure to set this level on the printer will result in failed print jobs.

Agfa print layouts

Custom layout must be configured by printer vendor for accurate image sizing. In addition to the above layouts, the following layouts must be installed by the Agfa print representative:

Table A-2 Agfa print layouts

Film size	Format	P/I	Agfa layout
14 x 17	1:1	P	2411
14 x 17	1:2	P	9001
14 x 17	2:1	P	9000
14 x 17	2:2	P	9002
14 x 17	1:1	L	2511

Table A-2 Agfa print layouts

Film size	Format	P/I	Agfa layout
14 x 17	1:2	L	9003
14 x 17	2:1	L	9004
14 x 17	2:2	L	9005
11 x 14	1:1	P	9014
11 x 14	1:2	P	9102
11 x 14	2:1	P	9103
11 x 14	2:2	P	9104
11 x 14	1:1	L	9018
11 x 14	1:2	L	9202
11 x 14	2:1	L	9203
11 x 14	2:2	L	9204
8 x 10	1:1	P	9006
8 x 10	1:2	P	9009
8 x 10	2:1	P	9008
8 x 10	2:2	P	9010
8 x 10	1:1	L	9007
8 x 10	1:2	L	9012
8 x 10	2:1	L	9011
8 x 10	2:2	L	9013

Section A.2 Agfa Drystar 5500 printer parameters

Table A-3 Agfa Drystar 5500 printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	DRYSTAR5500	Or customer preference
	Application Entry Title	Enter value given by site network administrator	AE titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	104	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	55.0	
	Configuration Information	LUT=0.0	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	140	
	Trim	NO	
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	40Mbyte	
Layouts	Select the desired layouts allowed for this printer	1:1, 1:2, 2:1, 2:2	
	Slide formats	Not applicable	Not supported; do not select

Table A-3 Agfa Drystar 5500 printer configuration information

Tab	Attribute	Value	Comments
Film Sizes	8 x 10in	Pixel width = 3852 Pixel height = 4300	
	10 x 12in	Pixel width = 4880 Pixel height = 5280	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = Pixel height =	
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = 6922 Pixel height = 7788	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Agfa print layouts

Custom layout must be configured by printer vendor for accurate image sizing. In addition to the above layouts, the following layouts must be installed by the Agfa print representative:

Table A-4 Agfa print layouts

Film size	Format	P/I	Agfa layout
14 x 17	1:1	P	2411
14 x 17	1:2	P	9001
14 x 17	2:1	P	9000
14 x 17	2:2	P	9002
14 x 17	1:1	L	2511
14 x 17	1:2	L	9003
14 x 17	2:1	L	9004
14 x 17	2:2	L	9005
11 x 14	1:1	P	9014
11 x 14	1:2	P	9102
11 x 14	2:1	P	9103
11 x 14	2:2	P	9104
11 x 14	1:1	L	9018
11 x 14	1:2	L	9202
11 x 14	2:1	L	9203
11 x 14	2:2	L	9204

Table A-4 Agfa print layouts

Film size	Format	P/I	Agfa layout
8 x 10	1:1	P	9006
8 x 10	1:2	P	9009
8 x 10	2:1	P	9008
8 x 10	2:2	P	9010
8 x 10	1:1	L	9007
8 x 10	1:2	L	9012
8 x 10	2:1	L	9011
8 x 10	2:2	L	9013

Section A.3 Codonics Horizon printer parameters

Table A-5 Codonics Horizon printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	HORIZON	Or customers preference
	Application Entry Title	Enter value given by site network administrator	AE titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	104	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	79.5	
	Configuration Information	LUT=LINEAR	
	Density	Min. = 0, Max. = 310	
	Magnification Type	REPLICATE	
	Smooth Factor	0	Not supported
	Trim	NO	
	Polarity	NORMAL	
	Border Density	BLACK	Can also pass OD value of 0-310
	Empty Image Density	BLACK	Can also pass OD value of 0-310
	Printer Memory Size	40Mbyte	
Layouts	Select the desired layouts allowed for this printer		
	Slide formats		

Table A-5 Codonics Horizon printer configuration information

Tab	Attribute	Value	Comments
Film Sizes	8 x 10in	Pixel width = 2406 Pixel height = 2790	
	10 x 12in	Pixel width = Pixel height =	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = 3376 Pixel height = 4072	
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = 4322 Pixel height = 5025	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Codonics Horizon general comments

Codonics Horizon printer supports clear film, blue film and paper.

Only 8 x 10 and 14 x 17 inch film formats have been validated.

Other smoothing and sharpening algorithms for magnification type are supported.

Consult Codonics technical representative to install customer preferences if desired.

Section A.4 Fuji FM DPL printer parameters

Table A-6 Fuji FM DPL printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	FUJIFMDPL	Or customer preference
	Application Entry Title	Enter value given by site network administrator	AE titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	104	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	100	
	Configuration Information	CS000	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	SHARP	
	Trim	NO	
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	40Mbyte	
Layouts	Select the desired layouts allowed for this printer	1:1, 1:2, 2:1, 2:2	
	Slide formats	Not applicable	Not supported; do not select

Table A-6 Fuji FM DPL printer configuration information

Tab	Attribute	Value	Comments
Film Sizes	8 x 10in	Pixel width = 1998 Pixel height = 2510	
	10 x 12in	Pixel width = Pixel height =	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = 2540 Pixel height = 3600	
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = 3500 Pixel height = 4240	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Fuji FM DPL general comments

The following configurations must be configured by the Fuji printer representative to print correctly sized images:

- LUT1 as SAR17 for calling AE_TITLE.
- Trim width at 1 pixel for calling AE_TITLE.
- Globally configure “a margin between image” for 0 pixels.
- Globally configure “Image layout” for spread.

Section A.5 Fuji DryPix 1000 printer parameters

Table A-7 Fuji DryPix 1000 printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	DRYPIX1000	Or customer preference
	Application Entry Title	Enter value given by site network administrator	AE titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	104	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	84.67	
	Configuration Information	CS000	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	SHARP	
	Trim	NO	
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	48Mbyte	
Layouts	Select the desired layouts allowed for this printer	1:1, 1:2, 2:1, 2:2	
	Slide formats	Not applicable	Not supported; do not select

Table A-7 Fuji DryPix 1000 printer configuration information

Tab	Attribute	Value	Comments
Film Sizes	8 x 10in	Pixel width = 2280 Pixel height = 2877	
	10 x 12in	Pixel width = Pixel height =	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = 2962 Pixel height = 4096	
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = Pixel height =	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Fuji DryPix 1000 general comments

The following configurations must be configured by the Fuji printer representative to print correctly sized images:

- LUT1 as SAR17 for calling AE_TITLE.-Trim width at 1 pixel for calling AE_TITLE.
- Globally configure “a margin between image” for 0 pixels.
- Globally configure “Image layout” for spread.
- A densitometer filter (FUJI part number 605S0003) must be used when performing printer calibration.

Section A.6 Fuji DryPix 3000 printer parameters

Table A-8 Fuji DryPix 3000 printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	DRYPIX3000	Or customer preference
	Application Entry Title	Enter value given by site network administrator	AE titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	104	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	84.67	
	Configuration Information	CS000	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	SHARP	
	Trim	NO	
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	48Mbyte	
Layouts	Select the desired layouts allowed for this printer	1:1, 1:2, 2:1, 2:2	
	Slide formats	Not applicable	Not supported; do not select

Table A-8 Fuji DryPix 3000 printer configuration information

Tab	Attribute	Value	Comments
Film Sizes	8 x 10in	Pixel width = Pixel height =	
	10 x 12in	Pixel width = Pixel height =	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = Pixel height =	
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = 4072 Pixel height = 4972	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Fuji DryPix 3000 general comments

The following configurations must be configured by the Fuji printer representative to print correctly sized images:

- LUT1 as SAR17 for calling AE_TITLE.
- Trim width at 1 pixel for calling AE_TITLE.
- Globally configure “a margin between image” for 0 pixels.
- Globally configure “Image layout” for spread.
- A densitometer filter (FUJI part number 605S0003) must be used when performing printer calibration.

Note: Only 14x17 film should be used with this printer. Any other film size used may print films with incorrect measurements.

Section A.7 Fuji DryPix 7000 printer parameters

Table A-9 Fuji DryPix 7000 printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	DRYPIX7000	Or customer preference
	Application Entry Title	Enter value given by site network administrator	AE Titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	104	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	50	
	Configuration Information	CS000	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	SHARP	
	Trim	NO	
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	48Mbyte	
Layouts	Select the desired layouts allowed for this printer	1:1, 1:2, 2:1, 2:2	
	Slide formats		
Film Sizes	8 x 10in	Pixel width = 3907 Pixel height = 4819	
	10 x 12in	Pixel width = Pixel height =	
	10 x 14in	Pixel width = 5075 Pixel height = 7043	
	11 x 14in	Pixel width = Pixel height =	
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = Pixel height =	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Fuji DryPix 7000 general comments

The following configurations must be configured by the Fuji printer representative to print correctly sized images:

- LUT1 as SAR17 for calling AE_TITLE.
- Trim width at 1 pixel for calling AE_TITLE.
- Globally configure “a margin between image” for 0 pixels.
- Globally configure “Image layout” for spread.
- A densitometer filter (FUJI part number 605S0003) must be used when performing printer calibration.

Note: Only 14x17 film should be used with this printer. Any other film size used may print films with incorrect measurements.

Section A.8 Kodak 8200 printer parameters

Table A-10 Kodak 8200 printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	KODAK8200	Or customer preference
	Application Entry Title	Enter value given by site network administrator	AE Titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	1024	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	78.15	
	Configuration Information	LUT=Wkstn2a.w87,2 (no spaces)	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	15	
	Trim	NO	
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	40Mbyte	
Layouts	Select the desired layouts allowed for this printer	1:1, 1:2, 2:1, 2:2	1:2 only valid for portrait 2:1 only valid for landscape
	Slide formats		

Table A-10 Kodak 8200 printer configuration information

Tab	Attribute	Value	Comments
Film Sizes	8 x 10in	Pixel width = Pixel height =	
	10 x 12in	Pixel width = Pixel height =	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = Pixel height =	
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = 3388 Pixel height = 4277	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Section A.9 Kodak 8500 printer parameters

Table A-11 Kodak 8500 printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	KODAK8500	Or customer preference
	Application Entry Title	Enter value given by site network administrator	AE titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	1024	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	78.15	
	Configuration Information	LUT=Wkstn2a.w87,2 (no spaces)	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	15	
	Trim	NO	
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	40Mbyte	
Layouts	Select the desired layouts allowed for this printer	1:1, 1:2, 2:1, 2:2	1:2 only valid for portrait 2:1 only valid for landscape
	Slide formats	Not applicable	Not supported; do not select

Table A-11 Kodak 8500 printer configuration information

Tab	Attribute	Value	Comments
Film Sizes	8 x 10in	Pixel width = Pixel height =	
	10 x 12in	Pixel width = Pixel height =	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = Pixel height =	
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = 3388 Pixel height = 4277	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Section A.10 Kodak 8700 printer parameters

Table A-12 Kodak 8700 printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	KODAK8700	Or customer preference
	Application Entry Title	Enter value given by site network administrator	AE titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	1024	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	78.1	
	Configuration Information	LUT=Wkstn2a.w87,2 (no spaces)	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	15	
	Trim	NO	
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	40Mbyte	
Layouts	Select the desired layouts allowed for this printer	1:1, 1:2, 2:1, 2:2	1:2 only valid for portrait 2:1 only valid for landscape
	Slide formats	Not applicable	Not supported; do not select

Table A-12 Kodak 8700 printer configuration information

Tab	Attribute	Value	Comments
Film Sizes	8 x 10in	Pixel width = Pixel height =	
	10 x 12in	Pixel width = Pixel height =	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = Pixel height =	
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = 4096 Pixel height = 5221	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Kodak 8700 general comments

The following configurations must be configured by the Kodak printer representative:

- Calling AE_TITLE must be declared in 9410 host table or print will be rejected.
- Pixel correction turned off.
- TFT emulation enabled. Landscape printing will be functional only if a Kodak 8800 is installed.

Note: Customer will get incorrect image sizing if unsupported formats (portrait 2:1 or landscape 1:2) are used.

Section A.11 Kodak 8900 printer parameters

Table A-13 Kodak 8900 printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label	KODAK8900	Or customer preference
	Application Entry Title	Enter value given by site network administrator	AE titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	1024	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	38	
	Configuration Information	LUT=Ver693c0.w87,6	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	40	
	Trim	NO	
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	40Mbytes	
Layouts	Select desired layouts allowed for this printer	1:1, 1:2, 2:1, 2:2	Check at least one (1:1); more as desired
	Slide formats		

Table A-13 Kodak 8900 printer configuration information

Tab	Attribute	Value	Comments
Film Sizes	8 x 10in	Pixel width = 4742 Pixel height = 6286	
	10 x 12in	Pixel width = 6286 Pixel height = 7342	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = 6712 Pixel height = 8896	
	14 x 14in	Pixel width = 8896 Pixel height =8662	
	14 x 17in	Pixel width = 8896 Pixel height = 10612	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Section A.12 Konica Dry Pro 793 printer parameters

Table A-14 Agfa Drystar 3000 printer configuration information

Tab	Attribute	Value	Comments
Printer	DICOM Printer Label		Customer preference
	Application Entry Title	Enter value given by site network administrator	AE titles may be site-specific, check with site
	Network Address	Enter value given by site network administrator	
	Port Number	6000	Port number may be site-specific, check with site
	Pixel Depth	12	
	Printer Pixel Size (micron)	43.75	
	Configuration Information	Dicom	
	Density	Min. = 20, Max. = 300	
	Magnification Type	CUBIC	
	Smooth Factor	1	
	Trim	NO	Not supported
	Polarity	NORMAL	
	Border Density	BLACK	
	Empty Image Density	BLACK	
	Printer Memory Size	512	

Table A-14 Agfa Drystar 3000 printer configuration information

Tab	Attribute	Value	Comments
Layouts	Select the desired layouts allowed for this printer	1:1, 2:1, 1:2, 4:1, 6:1	
	Slide formats		
Film Sizes	8 x 10in	Pixel width = Pixel height =	
	10 x 12in	Pixel width = 5766 Pixel height = 6826	
	10 x 14in	Pixel width = Pixel height =	
	11 x 14in	Pixel width = Pixel height =	
	14 x 14in	Pixel width = Pixel height =	
	14 x 17in	Pixel width = 8079 Pixel height = 9725	
	24 x 24cm	Pixel width = Pixel height =	
	24 x 30cm	Pixel width = Pixel height =	

Glossary

ADC or A/D	Analog to digital converter.
AE Title	Application entity title. Name used to identify the DICOM nodes communicating to each other. AE titles need to be locally unique, and are usually managed by a system administrator. They are case-sensitive and 16 bytes long, and are configured before initializing a DICOM connection.
BIST	Built in self test.
CAN	Controller area network. A serial communication method.
CANOPEN	Software communications protocol used in the CAN. Often called CAN.
CR-FALLBACK	Mode where, if the PACS rejects DX images, CR images are sent instead. This occurs only if the PACS does not support DX modality images, or if the PACS is configured to reject DX modality images.
DAP METER	Dose area product meter.
DICOM	Digital Imaging and Communication in Medicine. A standard for distributing and viewing medical images regardless of the source.
ELECTRO-STATIC DISCHARGE (ESD)	A transfer of electrostatic charge between objects at different potentials caused by direct contact or induced by an electrostatic field.
ESD	Electrostatic discharge
FPGA	Field programmable gate array. Programmed by the CPU core after a reset and handles all the exposure control logic including the system interface real-time lines.
FRU	Field replaceable unit. Spare part. This is a defined and GE-sanctioned assembly or component specifically designated as replaceable outside GE's controlled manufacturing or repair facilities.
GEHC	General Electric Healthcare.
HHS	United States Department of Health and Human Services. "HHS" is often used to refer to the specific testing procedures defined in 21CFR regulations.
HV	High voltage.
LAT	Lateral.
LFC	Load from cold. Complete software load.
LONG	Longitudinal.
LOTO	Lock out/tag out. Process defined by GEHC to ensure the safety of employees, specifically the process of energy control for service activities of GE products.
LSL	Lower specification limit.

LUT Look-up table.

MAINS Hospital-supplied AC power.

OLC On-Line Center. GE Healthcare department that provides support to field service personnel.

OS Operating system.

POS Positioner.

PWA Printed wire board. Synonymous with printed circuit board (PCB).

RAD Radiography.

SID Source to image distance. Distance from the X-ray tube focal spot to the image plane (or film cassette).

SPGP System power ground point.

SUIF Service user interface.

TORQUE 1 N-m = 0.738 ft-lbs = 8.85 in-lbs.

UIF User interface.

USL Upper specification limit.

© 2011, General Electric Company.
GE Medical Systems, a General Electric Company, going to market as GE Healthcare.
3000 N. Grandview Boulevard
Waukesha, Wisconsin 53188
USA

www.gehealthcare.com